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Heat-Treating Steering-Gear Parts

By F. W. Manker
Vice-President, The Surface Combustion Company

In the production of steering gears on a large scale the heat-treatment operations are standardized for uniform quality in the large number of parts

Manufacture of steering gears is a highly specialized branch of the automotive industry. Progressive changes in design and heat-treatment have brought the present types of steering gears up to a high standard of perfection, but research is still being carried on with the idea of further increasing performance and life.

The Ross Gear & Tool Company is one of the large manufacturers of this line, and furnishes steering gears for about a hundred different makes of trucks, thirty makes of passenger cars, and a large percentage of all the buses produced in this country. While some makes of steering gears use the worm screw, this concern has standardized upon a cam which actuates the trunnion shaft directly through a pin at one end of the shaft. The advantages claimed for this type include greater ease of steering, less road shock, steadiness at all speeds, easier manipulation in parking, and simplicity and sturdiness in construction.

More than two hundred different kinds and sizes of steering gears are made by this company, each individually designed for a special make, model, and type of car, truck, or bus. Whenever a new model is brought out by one of its customers, the engineering and research department of the company is called upon to redesign the steering gear. Of course, in the majority of cases this involves only simple changes in dies and tools.

In a typical type of steering gear there are fourteen parts which are listed in the following table, together with the kind of stock from which they are made:

1 Cam—bar stock
1 Trunnion shaft—forging
1 Housing—malleable iron casting
1 Side plate cover for housing—steel stamping
1 Steering-wheel tube or post—seamless tubing
2 Ball bearings (thrust) for top and bottom of cam—steel
2 Spark and throttle control levers—die castings or forgings
2 Spark and throttle control tubes—steel tubing
1 Steering wheel—wood, steel, die casting, or combination
1 Steering arm—forging.

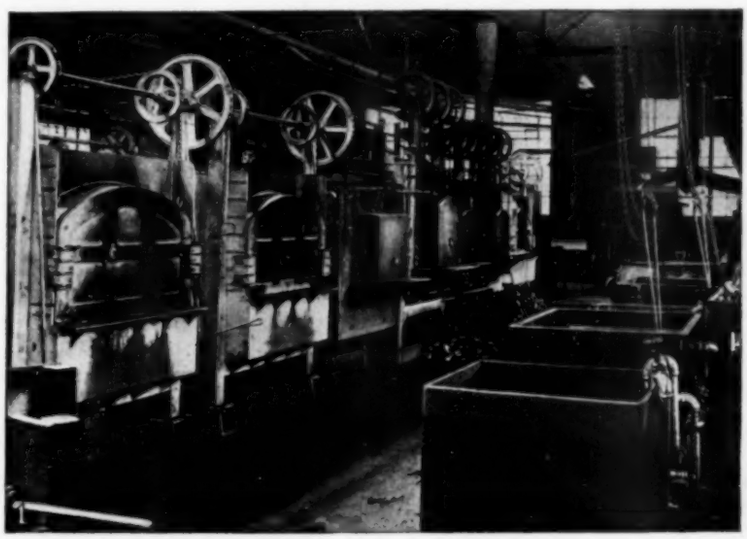
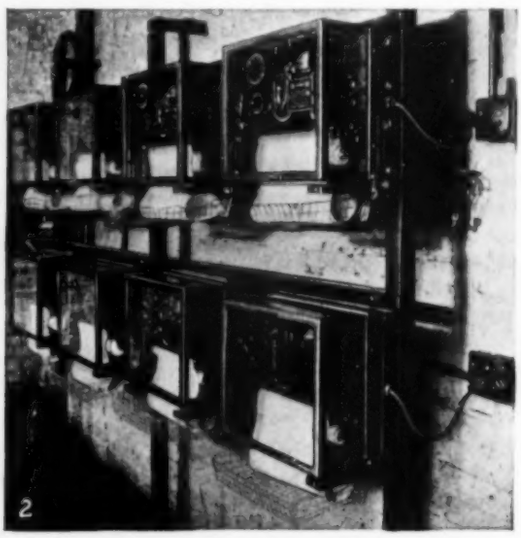


Fig. 1—Three of the furnaces in this group are equipped with burners giving double inspiration of air, permitting the furnaces to be brought up to heat rapidly. The gas flow is then reduced to a rate just sufficient to hold the heat. Fig. 2—A group of recording controllers for the gas-fired furnaces shown at the left



In making the cam several standardized operations are involved but the heat-treatment is specialized, and was worked out by the staff engineers. First, the cams are turned and formed from bar stock, S.A.E. 1315 or 2315, the latter usually being used. The keyway, where necessary, is then cut and the stock passed on to special lathes for shaving the ball races, after which the thread is cut in a cam-milling machine which was specially designed and built for the purpose. The parts are then washed in a gas-fired washing machine.

The first step in heat-treating is carburizing, after which the center hole is drilled. The cam is reheated for core refinement, reheated for case refinement, and then quenched for hardness. Finally, the external spline end is drawn in a lead bath. After the heat-treatment, the cam is sand-blasted, inspected for hardness, copper plated, and the ball races polished.

In carburizing, the cams are placed in gas-fired rotary furnaces with carburizing material, and heated to 1,680 to 1,700 deg. F. for seven hours. They are charged with the furnaces at that temperature, and it requires about one and a quarter hours for the work to attain this heat, leaving approximately 5¾ hours for a soaking period. This gives a depth of case ranging from 0.030 to 0.035 in. The charge is then dumped into a drum for cooling, and more compound is placed on top so that the cams do not come into contact with the air.

The next two heats in this treatment are accomplished in box-type gas-fired furnaces equipped with inspirators and venturis for proportioning the gas and air exactly to produce the correct furnace atmosphere, the latter may be oxidizing, neutral or carburizing. In this case a neutral atmosphere is required. These furnaces are 5 ft. wide, 6½ ft. deep, 5 ft. high, and each is equipped with seven gas burners. Temperatures are maintained and controlled with automatic pyrometers. Recorders are also used. The quenching tanks are located in front. The gas utilization equipment of these furnaces incorporates the principle of double-stage inspiration of air for combustion. In other words, there is both primary and secondary entrainment of air. This is a distinct improvement over single-stage inspiration, as it more than doubles the range of turn down from maximum to minimum. For instance, if the same furnace is used for both hardening and drawing, with a temperature range of from 900 to 1,600 deg. F., either temperature, or all intermediate temperatures, can be had with a single set of burners. Furthermore, considerable reduction in fuel consumption is obtained with the double-stage inspirators by reducing the flow of gas to a rate just sufficient to hold the heat after the furnace has been brought up to temperature. Back-fire is eliminated with double-stage inspiration.

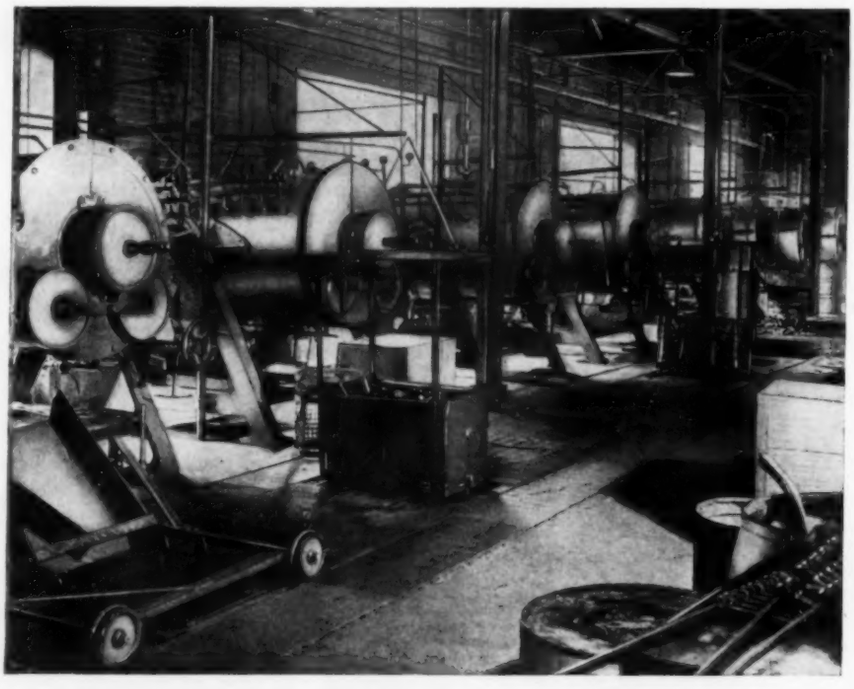


Fig. 3—Eight rotary carburizing furnaces operating on high-pressure gas. The car at the lower left-hand corner dumps the work into the quenching tank in the floor, the work being guided into baskets, two of which are shown raised to the floor level

The cams are placed in these furnaces and heated to 1,525 to 1,550 deg. F. for a period of time sufficient to refine the grain of the core. Inasmuch as S.A.E. 2315 steel contains about 3½ per cent of nickel, the cams are quenched in oil to prevent checking. They are left in the quench for from 5 to 10 min., or until cold. This treatment refines the grain of the core, but leaves a coarse grain in the case.

When cold, the cams are reheated, but this time the temperature range is reduced about 100 deg. F. The heating period is the same as before, and the cams are quenched in the same quenching medium. This last treatment refines and hardens the grain structure of the case without affecting the grain of the core, and therefore produces a hard, fine-grained wearing surface, having a minimum of brittleness, and gives a soft, fine-grained core having a maximum of toughness. The core contains 0.15 per cent of carbon, and the case from 0.95 to 1.00 per cent, the correct ratios having been worked out after considerable research had been made and as a result of long experience.

Circulation through a cooling medium is employed to keep the quenching oil cool, and the system is controlled automatically with a thermostat. There is a separate reservoir outdoors, oil being piped to the quenching tank. A cooling chamber is cut into the line, and the oil is passed through this in coils which are immersed in water. As the temperature of the oil rises during quenching, the thermostat admits more cold water into the cooling chamber and coils until the oil is cool again, at which point the water is shut off. Running water from the city mains is sufficient to keep the oil at from 90 to 110 deg. F., although the thermostat can be adjusted for any temperature. Centrifugal pumps keep the oil circulating continuously. Some cams, as previously stated, have an external spline end, and the drawing of this end is the final step in the heat-treatment. The cams are placed in fixtures which allow only the spline end to come in contact with the molten lead. A lead pot set in a brick foundation is utilized, and the exposed part is heated to 1,300 deg.

Fahrenheit for a period of about one minute duration.

The trunnion shafts are drop forgings made from S.A.E. 1020, 3120, or 4615 steel, and are normalized when received, the normalizing consisting of heating to 1,550 or 1,575 deg. F. for from 1½ to 2 hours, and air cooling for 2 or 3 hours. The carburizing of the shafts is accomplished in identically the same way as that of the cams, with the exception that the shafts are quenched directly from the carburizing heat instead of the slow cooling which the cam receives.

In another heat, the box type of furnace is used, and the work is subjected to a temperature of from 1,425 to 1,450 deg. F., and quenched in either oil or water. The thread end is then drawn at from 1,250 to 1,300 deg. F. for one min., and allowed to cool in the air. This gives the maximum toughness and ductility for this class of work. The heat-treating department is equipped with an overhead monorail system and with hoists to aid in handling the work. The gas is supplied to the furnaces at 15 lb. pressure.

A Simple System for the Small Shop—*Discussion*

By R. C. Hewitt
York, England

THE article by T. Elison Kelly on page 730, Vo. 69, of the *American Machinist* has the disadvantage of turning the foreman into an order clerk and a recording clock. The type of job card shown, being for only one operation, also increases his clerical work, and the method of time recording leaves much to be desired.

If an accurate time record by this method is to be maintained, the foreman must be always on the spot. This means that the men are under constant observation, which is irksome even to the best of craftsmen. It is also questionable whether or not the foreman will be able to keep up to the men as they finish their jobs.

It is evident that unless the shop is small, employing less than forty men, the above system is inadequate and takes so much of the foreman's time that he is debarred from doing what Mr. Kelly advocates—"make a study of his job, his men, and his equipment every working day of his life."

The following system overcomes these defects, insures accurate cost keeping, and allows the foreman to fulfill his duties as supervisor. In a small shop making in-

PRODUCTION CARD

Order Number CL3/s 19 Date 3-12-28

Name of Part Cylinder Crank End

Class of Material Semi steel Drg. No. CL3/s A

PLEASE KEEP CLEAN

Ops.	Discription of Operation	Name	No.	Time Started	Time Finished	Total	Inspectors Initials
1	Bore + Face	J. Jones	414	755 A.M. Dec. 3			
2	" Flange Side	"	"		2.25 Dec. 3	5-30	JER
3	Bore + Mill	J. Smith	415	9-0 Dec. 4	9-0 Dec. 5	8-35	JER
4	Drill + Tap	W. Wilson	430	10-0 Dec. 5	5-0 Dec. 5	6 hrs.	JER
5							
11							
12							
13							
14				Received from Dec. 6, 1928	J. E. W. Henderson		

A production job card for keeping track of time by the job, instead of by operation, in the small shop

ternal combustion engines, employing about fifty hands in the machine department, it has proved entirely satisfactory.

Orders with specifications are sent to the rough storekeeper. The storekeeper checks his stock lists, making out an order to the foundry for castings to complete his specification. In due course the castings are received, and the production card shown in Fig. 1, which has been made out in the meantime by the storekeeper, is placed on the job.

Notes as to the peculiarities in the method of the work, such as the recommended speeds and feeds, gages required, and special tools, are placed on the drawing instead of on the production card, thus saving considerable clerical work. These instructions are placed in a neat square along the bottom of the drawing, a square for each operation.

A pile of work is always by each machine, and the foreman plans his work for days ahead by instructing his men as to the order in which the various jobs are to be machined. Production cards for bar work are handed to the foreman who gives them to the operators in the desired order. Bars are delivered from stores on receipt of the production card, and remaining ends are returned after the job is finished.

On commencing a job the operator goes with the production card to the storeroom where gages and tools are kept. The operator receives the gages he requires, and his name and number is written on the production card by the storekeeper. A small recording clock is used for stamping. When the job is completed the man takes back the drawing and tools, and a production card for his next job, which is "run on" immediately the other is "rung off." The work is then sent to the inspection department. One inspector is sufficient, and he records his signature after inspecting the job, and then fills in the name of the man to whom the job goes next. Jobs for inspection are placed at one end of the bench and inspected jobs at the other, so that the laborer can see at a glance what work is ready for moving, and, by consulting the card, move it to the right machine.

When the pieces are finished they are taken to the finished stores and are entered in the ledger. They are eventually issued to the erecting department under an engine number. Production cards of the same order number are tied together and forwarded to the cost department as an accurate record of the job.

To keep a check on the operators' time, a clock recording system is in use. The time cards are taken out of the rack and sent to the storekeeper. When an operator comes with a production card he writes the job and order number on the back of operator's time card and stamps that also. These cards are totalled up at the week end by the time clerk. Any difference in totals is reported to the foreman who has to account for the missing time. Should an operator be out of a job through a machine breaking down or any other reason, the foreman gives him a slip of paper bearing his signature, stating the cause of the delay.

Rewards for Suggestions

"YOU'RE an advocate of the suggestion box scheme, I believe, Bill," stated John Black at the Business Men's Club the other noon.

"Guess I am, John," replied Bill Holland. "The suggestion box has worked out well in many cases. Of course it won't run itself—it takes brains to get the most out of it. What's your particular trouble?"

"Well, Bill, we put it in last year. For the first three months we were flooded with ideas—most of 'em punk. But every man who took the trouble to put in a suggestion thought he ought to have a prize. Then some of the men swore the foremen swiped their ideas and put their own names on them."

"It's just possible there's some truth in it. It's been known to happen, although I don't think it's at all common. But, if that's your only trouble you can easily furnish suggestion slips with an identifying number so that no one knows who gives the suggestion. The man keeps a tab with the same number, and only makes it known if the suggestion wins an award. Such suggestion cards can be bought, or you can print them yourself."

"But that isn't all, Bill. The average man overrates the value of an idea, especially if we adopt it. He doesn't feel satisfied with a five or ten dollar prize, when that may be all it's worth."

"That, of course, is a real problem. However, if you'll use a little of the tact you keep for customers, you'll be able to show the men why a five dollar idea isn't worth fifty. One trouble is that some concerns try to put a flat price on ideas, and think the man ought to be satisfied with anything they give him. They don't want to give any more reward for a suggestion that reduces the cost of making a part of their product than they do for a specially shaped flower bed that takes their fancy."

"Well, Bill, a flat reward is *so* much easier to handle."

"Of course it is. It would be a lot easier for you to buy machines at so much per—but the maker usually has the idea that the price ought to depend somewhat on how much they save you. So you frequently pay more for a small machine than for a larger one of some other kind. If you get an idea for a change in design or in a fixture that saves you real money, you can afford to pay well for it. And if you do pay well, it incites others to evolve ideas that will save you more money."

"But it's so hard to fix on any amount that is fair to us both. We may spend a lot in developing an idea, and while it may save us money for a while, we may abandon the part, or some one else may dig up a better plan. What then?"

"The average man is fairly reasonable, John, if you play the game with him, and show him all the cards. You can show him what it cost to get the idea in shape to use, and he'll appreciate being taken into your confidence. One plan is to give a flat reward, say fifty dollars. Then keep track of the savings effected, and pay the man a part of the savings each month or quarter. It makes a little bookkeeping, to be sure, but it keeps up interest in improving methods. The man looks forward to a little extra money at regular intervals, and tries to devise other ways of saving costs. Other men know about the bonus or royalty the lucky chap gets, and they try to find some improvements of their own. As a stimulator of interest it's hard to beat."

"It would stimulate all right, Bill. But we get more fool notions now than we get time to read."

"Probably pass up some good ones, too. That's another danger, John. As with everything else I know of, you don't get something for nothing. You've got to have someone with good judgment look over all suggestions and pass on them as promptly as possible. After the impossible ones are weeded out, you must spend more time on the others. The value of suggestions can be killed quicker by carelessness or indifference on the part of the management than in any other way that I know."

"Guess I've taken the idea too casually, Bill. I can see it's a real job in itself if it's run right. It's up to us to decide whether to run it right, or to drop it."

EXECUTIVE FORUM

Executives are invited to discuss the problem involved in the foregoing case. They are also urged to use this department to air their own problems. A letter to the Executive Forum Editor is all that is needed.

Discussion

Should the Buyer Specify Design or Results?

The meaning of the word guarantee has been considerably altered by custom and usage. In a legal sense the one who gives the guarantee becomes personally responsible for the complete performance of the act or of the contract which is guaranteed. How far the present commercial meaning of the word guarantee differs from the above conception, may be judged from a careful study of the standard sales guarantee of the automobile manufacturers, or the recently adopted standard guarantee for machine tools.

It would, of course, be unreasonable to expect the builder to give a complete guarantee of the performance of any machine operating under someone else's supervision, to the extent of indemnifying the purchaser for all incidental losses due to trouble with the machine. This risk, which the seller will not assume, must therefore be assumed by the buyer. Has not the buyer then the right to force the seller to adopt any mechanical improvements which will minimize his chances of loss? The big companies all do this, and the smaller ones would, if they could bring more pressure to bear upon their suppliers in a way to secure the desired results."

Examples are not lacking of improvements, forced on the maker in this manner, which later became talking points for the machine. Consider how many years it has taken the manufacturers to adopt ball and roller bearings and built-in conduit boxes as regular equipment on electric motors; and how loudly they now proclaim the virtues of these improvements. Think how many lubricating devices are being sold for installation on machines which were supposed to be complete when they were shipped. —C. S. HAZARD.

Preventing Unfair Rejections

The fact that, during a rush, parts had been accepted which were not exactly to drawing is not a good excuse for the supplier to expect all his dud parts to be taken over.

This may sound drastic, but who is to decide what the tolerances shall be, the supplier, or those who are to use them? If the contract is based on the buyer's drawings, the goods should conform to those drawings; and if the supplier considers that the tolerances could be wider with no loss in the value of the finished machine, then he should quote to drawing, giving a price that will cover himself while conforming to that drawing, and also a price for the parts to his own suggested tolerances. This would be fair to both parties. Quoting a low price while not intending to conform to conditions is taking an unfair advantage over honest competitors.

Anyone with experience in buying parts knows that when parts arrive that do not conform to drawings, it is a question of altering the parts, or the mating pieces, or rejecting the lot and letting your customers down on delivery. As a rule, your own delivery dates depend on the delivery of parts, and there is seldom sufficient time to wait for a new batch to be put through.

If an impartial engineer looks over the rejected parts and finds that they do not correspond with the drawings how can he decide for the supplier if the contract says "to drawing?"

—ALBERT F. GUYLER, *England.*

Just as long as a few manufacturers stand for unfair rejections, all will have to. There is some relief through the contact of the salesmen of one firm with those of another. I remember one time when I had an inquiry from a firm whose rating was most excellent. On the way to see them I met a salesman for another, but not competing, firm who told me that the concern I was going to visit had rejected two machines in succession from a firm to which most men would hesitate about writing a letter of complaint.

Inasmuch as I was "nobody," I made up my mind that if I got the order I would have some expense making the machine "stick," so I boosted the price from $600 to $750. As luck would have it, it cost only about $50 to make the changes which they demanded, so I guessed wrong. However, the sum total that they paid for their reputation must have been very considerable, and, I hope, enough to pay all the manufacturers for their trouble.

Some one once said, "The customer is always right." It has a catchy sound. It appeals to the customer. In a case where a sale consists of taking goods from a shelf and putting them back if returned, it is an entirely different thing from one that involves a month's use of a machine and freight charges for a thousand miles. If customers were invariably honest and well posted as to what they should expect there would be no trouble, but many customers do not know and a few are not honest. —ENTROPY.

Day Work or Piecework?

Like many others, I looked upon piecework as a panacea for our many production drawbacks. Piecework promised the working man a more equitable income, and management an increased income by reason of greater production from the same equipment. The buying public

was also to be a gainer, since the article, being produced in greater numbers in a given time with equal facilities, could be sold for less.

One of the first by-products of piecework was the rate-setter. He based his studies on a worker who understood his work and equipment thoroughly and took pride in them, or the test was made in the laboratory under ideal working conditions, or finally, the rate was established by an efficiency expert. Under these conditions it was only reasonable to suppose that miscalculations would have to be readjusted, and since these readjustments usually followed a downward grade, piecework lost favor with the men. The very incentive which we hoped would urge them to their utmost, became its own drawback.

In order to forestall these reductions, the workmen decided upon a limited production. The management, in order to justify their position and incidently gain new recruits, retained certain work at a higher scale, or had it performed upon more efficient equipment. It is the wage-scale for these jobs which is broadcast, and lures on adventurous spirits, whose enthusiasm, however, is dampened almost before their first day's work is done.

The very fact that piecework is so vulnerable to attack gives evidence of its inherent weakness. If it is such a failure, then what would I advocate? Let the powers that be adopt a reasonable amount as a standard of production. Let the man realize that unless the average of such an amount of production is forthcoming, his job is in danger. The employer, by past records and experience, ought to be in a position to know what production he can reasonably expect from men and equipment. Do not forget that where a man lags behind in one operation, he is apt to speed up in another. —Wm. Schirmer.

The Man Over Fifty

Looking at this subject through European eyes, I would say that the mechanic of fifty is today, if in good health, a very valuable man with at least ten more year's good work left in him. He has more stamina than the present-day man of twenty-five or thirty, and certainly more sound judgment and experience. Medical men on this side of the water will tell you that the inferior food furnished during the World War has left its mark more on the younger men than on the older ones. The man of thirty was only in his youth—sixteen years of age—in 1914 and was probably just apprenticed to the trade.

During the following four years, rations were inferior and short, long hours were worked, excitement ran high and his apprenticeship was not as it should have been in normal times, all of which has been a great hardship to him. The man of fifty is the more valuable because of these things, as the following facts will show: He was thirty-six in 1914 and in many instances he had served over twenty years in the workshop, besides having gotten over his youthful growing stages. Moreover, he was more inured to long hours than was his younger brother.

The man over fifty may appear to be slightly slower in movement; in some cases his productive power is not so high as that of the youth, but this is compensated for by his doing his work more thoroughly and not making a large percentage of scrap, also not losing so much time.

The inspection departments, metal stores and toolcribs are some of the places in which men over fifty can be placed. I am sure it would be a paying proposition if some of our large firms were to make some of these old timers into instructors. It would relieve the department superintendents to a great extent. Also, we should not hear so much about operators not being able to read blueprints. These old hands should not be scrapped so long as their healths enable them to help production. Remember, when you scrap the man, *you scrap all his knowledge with him.*

—R. L. Haselgrove, *England.*

Idle Machines and Net Profits

The profit and loss sheet of any industry is based largely on the output of the machines; any change in production has a direct effect on the balance shown on the sheet. When a new machine will do more work in the same length of time, with the same amount of power, light and heat, floor space and labor, it will pay to make a change. Sometimes, of course, there is not enough work available to keep the new machine running at capacity and the possible earnings of the machine cannot be realized in full. But the larger output and decreased operating and labor costs will lower production costs so that the new equipment can stand idle for a longer time and still be more profitable than the old. The unused capacity creates a reserve for emergencies or a sudden increase in sales, and provides for the steady growth of the business at no added outlay of capital.

—L. O. Brown.

Of course, the more the buyer uses a machine that saves him money, the more it saves. But if it saves enough to pay a dividend on the investment, he is losing money if he does not get it. After all, it is the net result that counts. Along similar lines, if the machine buyer could invest capital safely at 25 per cent for six months of the year, he could let it lie idle the rest of the time and still earn double what he would at six per cent the year round. It is the same with machines. —John B. Sladen.

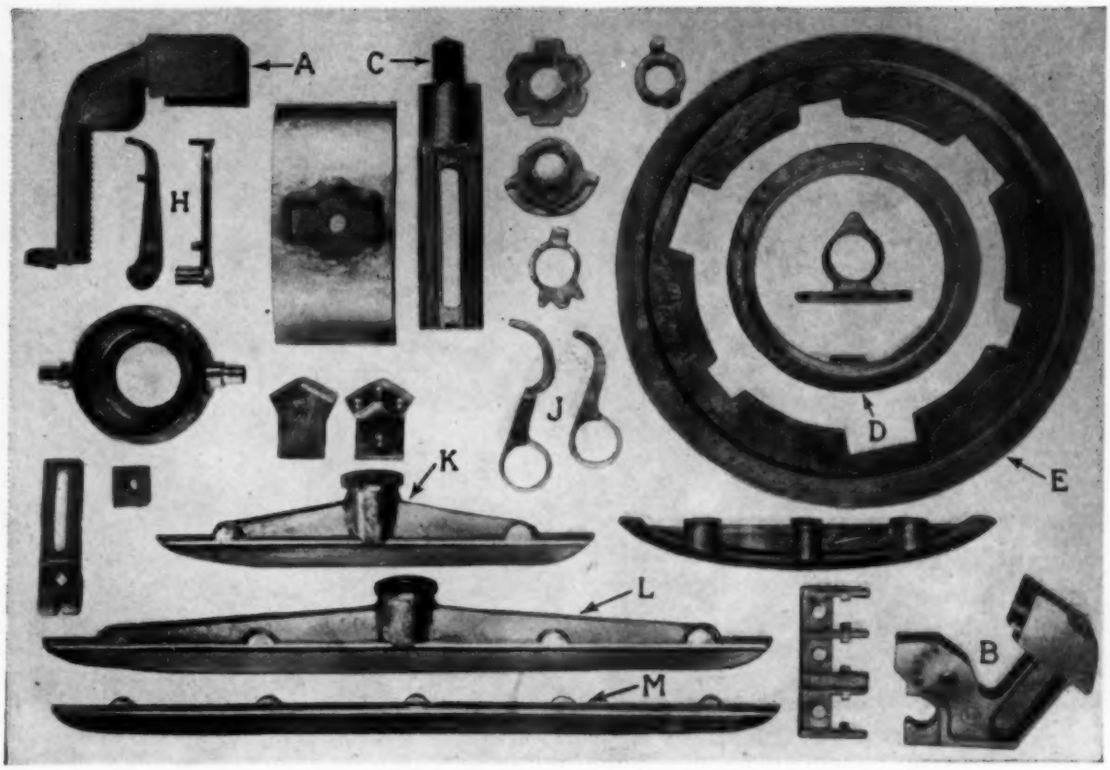


Fig. 1—Some typical parts of aluminum bronze cast in permanent molds, showing the wide variety of sections possible

Aluminum Bronze Cast in Permanent Molds

By W. R. Williams
Westinghouse Electric & Manufacturing Company

THE value and superiority of permanent-molded aluminum bronze castings over sand-cast brass castings has long been recognized and conceded, but, heretofore, the short life of the molds has prohibited extensive production of the former. This obstacle to production has been largely overcome by the Westinghouse Electric & Manufacturing Company who are now successfully making castings weighing as much as 7 lb. and this is by no means a limiting size.

Due to the great number and variety of parts manufactured by this company, there are many items which, from a cost reduction and quality standpoint, lend themselves very admirably to this process. Castings of intricate design requiring machining operations are especially adaptable. They are cast so that further finish is unnecessary with the exception of the drilling and tapping of small holes.

The size of holes that can be cast is governed by the volume of metal around the core. A large hole with a thin wall section around it can be cast with very little mold upkeep, whereas a small core with a heavy section around it becomes so hot that metal shrinking on it has a wire-drawing effect, stretching the core out and pulling it apart. All cores should be given as much taper as possible, and the body of the core should be from $\frac{1}{64}$ to $\frac{1}{32}$ in. larger than the portion entering the casting. This construction prevents the portion entering the casting being scored when withdrawing it. All cores, slides, and ejector pins should have 0.005 in. clearance to allow for expansion and to prevent scoring.

The life of the mold is governed by the volume of material in the largest cross-section of the casting being made, and also by the speed of operation. Hence, when designing a casting to be permanent molded, care should be taken to have the walls or body of the casting as light as possible. Thin walls are very easy to cast and show a better finish than the heavier sections. They also come out sharper, as in die casting, where the heavier sections show a duller and rougher finish.

The speed of operating the mold must be governed by the size of the casting and the amount of heat transmitted to the mold from the casting. Small castings can

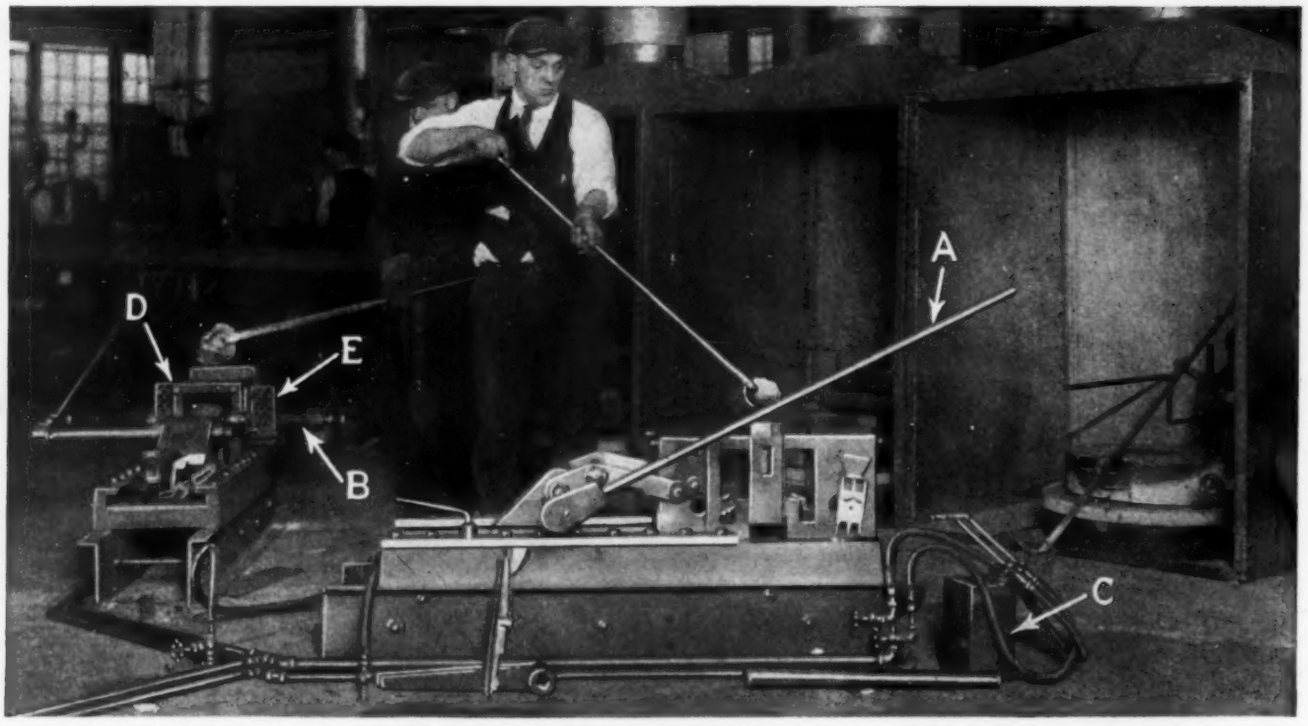


Fig. 2—A pair of operating fixtures, employing a toggle arrangement for opening and closing the molds. Permanent mold casting makes possible thin sections and eliminates machining

be poured more frequently than larger castings. The best system is to have a series of molds and to have one man pouring while one man operates each mold. In most cases it is preferable to take the casting from the mold before the gate solidifies. The molds should be placed in a fixture permitting the quick opening of the mold, pulling of cores, and the ejection of the casting. Side cores and slides can be withdrawn by toggles or pinions, the latter being preferred.

Machining a vent across the face of a mold, as in die casting, is not desirable as the metal flashing out into this vent makes the casting hard to clean, unless a trimming die is used. The better way is to cut a groove from the impression to the top of the mold. This also acts as a riser, and leaves only one portion of the casting, other than the gate, to be cleaned. The most approved method of gating is to place the gate on one side of the casting, allowing the metal to enter the mold from the bottom of the impression. Gating directly from the top is very detrimental to the portion of the impression where the metal strikes.

Sectional Molds Not Desirable Because of Spreading at Joints

While it is sometimes easier to build a sectional mold for this material, it is very undesirable because the corners of the sections will not radiate the heat; consequently they expand and, when cooling, shrink apart leaving an opening between the sections that will continue to get larger as the mold is used, making a fin on the casting and causing it to become warped when ejecting it.

The heating of the metal is done either in a crucible furnace using gas or fuel oil for fuel, or in a high-frequency electric furnace. From every angle the latter method is the more desirable.

For this class of work a small amount of iron is desirable in the aluminum bronze. The iron in the form of thin strips, stampings, or slugs, is added to the molten aluminum. The pieces of iron should be bent to prevent their clinging together and thus retarding the dissolving action of the aluminum. Occasional stirring during the dissolving process is advisable. To prevent oxidation, it is necessary that the iron be kept completely submerged. The iron and aluminum alloy is formed into bars, and, in this process, constitutes what is known as the hardener.

This hardener is added to the molten copper, while the whole mass is stirred. The metal should be melted as quickly as possible, taking care not to overheat. If the metal has stood overly long, causing it to run sluggishly, a good flux should be used.

Examples of Castings

In the headpiece, Fig. 1, are shown some specimens of aluminum bronze parts cast in permanent molds, indicating the possibilities of eliminating machining by using this process. Parts *A* and *B* are brushholders which are cast finished except for broaching. A mounting bar for *A* is shown at *C*, and has a threaded steel insert cast in place. Items *D* and *E* are collector rings, the larger being $9\frac{1}{2}$ in. in diameter, while *H* and *J* are brush-holder fingers. The trolley wire hangers, *K* and *L*, are cast on a formed copper insert similar to *M*. The thinness of walls that can be cast is indicated at *J*, the metal around the hole being only $\frac{3}{64}$ in. thick. Sections as thin as 0.020 in. have been successfully cast.

In Fig. 2 are shown two views of an operating fixture which has proven very satisfactory. The lever *A* operates a set of toggle links for opening and closing the molds. The pinion *B* moves the slide *C* inside the die mounting head, and is used for pulling the cores and ejecting the casting when it is necessary to perform both of these operations from the same half of the mold. The core plate is attached to *C* and the ejector plate is operated by tie bars passing through *D* and *E* on the mounting head for the opposite mold.

Influence of Regrinding Practice *on the* Efficiency of Cutting Tools

By Professor N. N. Sawin
Research Engineer, Skoda Works, Pilsen, Czechoslovakia

Limits, based on test results, are placed on the permissible loss of hardness due to the heat generated in dry grinding

IT IS well known that the manner in which a tool is sharpened on the grinding wheel has considerable influence on its efficiency. A careful and slow removal of stock from the dull cutting edge preserves the correct cutting properties of the tool, while quick and coarse grinding produces a reduction in the cutting life. Even when the correct grade and hardness of grinding wheel and suitable surface speed have been selected, the cutting edge of the tool may be ruined by using too large a feed, or by trying to take off too much stock in one pass. This refers mainly to the dry grinding of small tools such as reamers, taps, and milling cutters. Carbon-steel tools require much more attention than high-speed steel tools, because the temper is drawn by the heat.

In Table I are given the results of tests with carbon-steel taps 38 mm. (1.495 in.) in diam. and 1.5 mm. (0.059 in.) lead. These taps were ground several times, once very carefully, and once quickly in the customary way when the grinding is paid for by the piece. The taps worked in the same stock, heat-treated to a tensile strength of 85 to 90 kg. per sq. mm. (120,000 to 128,000 lb. per sq.in.), and the holes were drilled with the same drill. After quick and slipshod grinding the edge was burned and broken out, and the number of holes produced with such a tap was low, whereas, after correct grinding the efficiency increased to a remarkable extent. Improperly ground taps are indicated in the table as "burnt," and properly ground taps as "O.K." In some cases the time required for grinding has been stated. Investigation of the causes of incorrect work or poor efficiency of taps manufactured by the leading European and American makers has shown that, in approximately 70 per cent of all cases, the cause lies in incorrect grinding, and only 30 per cent can be ascribed to other causes such as too small tap drills, poor and streaky stock, incorrect cutting speed, and incorrect lubrication.

Table I.—Effect of Regrinding Time on Cutting Life of Taps

No. of Tap	Condition After Regrinding	Time Required For Regrinding Min.	Sec.	No. of Holes Tapped After Regrinding
	O.K.	..	..	75
1	Burnt	..	..	4
	O.K.	6	25	62
	O.K.	..	..	105
2	Burnt	..	..	3
	O.K.	7	25	75
	O.K.	..	..	130
	Burnt	..	..	14
3	O.K.	5	52	96
	Burnt	1	40	8
	O.K.	..	..	87
	O.K.	..	..	110
4	Burnt	..	..	8
	O.K.	6	..	82
	O.K.	..	..	37
5	Burnt	1	30	2
	O.K.	..	..	30
	O.K.	..	..	106
6	Burnt	..	..	6
	O.K.	6	42	98
	Burnt	..	..	13

The above remarks refer equally well to other small tools, as for instance reamers, thread mills, and form mills for gear cutting. A considerable variation in the efficiency of these tools after grinding is due mainly to methods of grinding. Piece rates, and especially low piece rates, for tool grinding are often very harmful.

When tools are ground dry by means of a correctly selected wheel running at a correct surface speed, there is the question as to the maximum possible stock that may be taken at one pass, and the maximum feed which will produce no noticeable reduction of the cutting qualities of the edge. The damaging of the cutting edge is generally caused by heating with consequent reduction in hardness, and on that account measurements of the Brinell hardness, before and after grinding, furnish reliable data for safe grinding.

The Brinell hardness in these tests was determined by means of the Vickers machine, which is well known as a most reliable instrument. Grinding was done with a Norton wheel, J-60, with a surface speed of 30 meters per sec. (6,000 ft. per min.). Out of tested stock, both carbon and high-speed steel, polished, prismatic blocks as shown by Figs. 1 and 2, were made, hardened, and tempered in the usual way. Particular attention was paid to preliminary heating to obtain a uniform hardness. The tests were carried out in two ways: One set of blocks, as shown by Fig. 1, was ground in successive strips, on two sides of 0.7 mm. (0.028 in.) wide with a mechanical feed of 3.5 m. (11.5 ft.) per min., and the stock "h" taken off varied from 0.01 to 0.52 mm. (0.0004 to 0.020 in.). The other set of blocks, shown by Fig. 2,

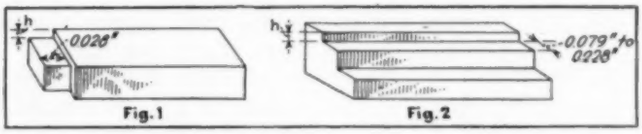


Fig. 1—One set of test blocks was hardened and ground crosswise and the other set, shown by Fig. 2, was hardened and ground lengthwise

Table II—Influence of Rate of Stock Removal on the Hardness of Cutting Edges (Grinding Lengthwise)

Steel	Grinding Conditions: Depth, in.	Width, in.	Feed, ft. per min.	Brinell Hardness Before Grinding: Highest	Lowest	Average	Loss in Brinell Hardness: After grinding first side	After grinding second side	Average	Heat-Treatment
High-speed chromium-tungsten steels	0.0024	0.118	9.5	811	802	806	...	82	62	Heated to 850 deg. C.; cooled; heated to 1,300 deg. C. in gas furnace; cooled in air; drawn at 580 deg. C. in lead bath.
	0.0022	0.118	9.5	831	793	819	43	...		
	0.0020	0.110	12.8	...	...	821	79	...	92	
	0.0020	0.118	12.8	873	821	846	...	104		
	0.0035	0.118	9.5	862	841	851	58	...	79	
	0.0033	0.118	9.5	862	811	842	...	100		
	0.0039	0.102	12.8	841	811	823	...	110	105	
	0.0037	0.102	12.8	862	811	835	101	...		
	0.0031	0.138	11.2	884	851	864	54	...	54	Heated to 850 deg. C.; cooled; heated to 1,290 deg. C.; cooled in air; drawn at 580 deg. C. in lead bath.
	0.0031	0.118	11.2	873	851	864	...	54		
	0.0016	0.102	11.2	873	802	835	6	...	8	
	0.0020	0.095	11.2	841	802	825	...	10		
	0.0028	0.108	11.2	841	766	832	...	25	24	
	0.0028	0.118	11.2	841	821	832	22	...		
Alloy tool steels with 0.8 to 1.2 per cent of tungsten	0.0020	0.108	9.5	918	884	900	...	134	124	Heated to 200 deg. C.; cooled; heated to 750 deg. C. in gas furnace; quenched in water; drawn at 100 deg. C. in muffle furnace.
	0.0020	0.108	12.8	906	895	901	114	...		
	0.0031	0.110	9.5	929	895	910	228	...	256	
	0.0039	0.138	9.5	929	918	925	...	285		
	0.0012	0.106	11.2	862	811	841	...	40	34	Heated to 200 deg. C.; cooled; heated to 790 deg. C. in gas furnace; quenched in water; drawn at 100 deg. C. in muffle furnace.
	0.0016	0.095	11.2	895	862	882	27	...		
	0.0022	0.095	11.2	811	766	787	189	...	213	
	0.0022	0.126	11.2	884	811	865	...	237		
Carbon tool steels	0.00039	0.134	11.2	929	906	922	...	37	36	Heated to 200 deg. C.; cooled; heated to 780 deg. C. in gas furnace; quenched in water; drawn at 100 deg. C. in muffle furnace.
	0.00039	0.134	11.2	906	884	899	35	...		
	0.0020	0.079	11.2	873	831	854	...	217	186	
	0.0022	0.110	11.2	918	873	900	156	...		
	0.0031	0.138	11.2	929	862	911	...	344	338	
	0.0031	0.138	11.2	918	895	912	331	...		

was ground lengthwise and on two sides on a width of 2.0 to 5.8 mm. (0.079 to 0.228 in.) with a standard, slow and fast mechanical feed of 3.4, 2.9 and 3.9 meters (11.9, 9.5 and 12.8 ft.) per min., and the stock "h" taken off varied from 0.01 to 0.10 mm. (0.0004 to 0.004 in.). The hardness was tested close to the edge in 5 or 6 places, and the highest, average, and lowest hardnesses were noted. A reduction in hardness was observed twice: after grinding the first edge, and after grinding the neighboring one. A considerably larger reduction in hardness was always observed on the neighboring edge, which proves the harmful influence of the heat set up by grinding. Typical data from the tests are listed in Tables II and III for both lengthwise and crosswise grinding operations.

Because of unavoidable errors in measuring Brinell hardness with a Vickers machine, and because of natural differences in the hardness of different layers of the

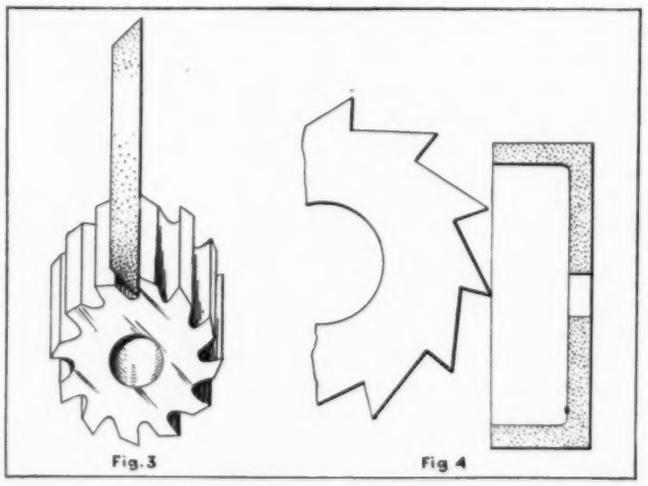
Table IV—Permissible Thickness of Stock to Be Removed in One Pass When Grinding Dry

Grinding Along the Edge; as shown by Fig. 3; Width of Cut 0.118 in., Feed 9.84 ft. per Min.

Steel	High-Speed Steel	Alloy Tool Steel	Carbon Tool Steel
Maximum thickness, in....	0.00315	0.00197	0.00118
Standard thickness, in.....	0.00197	0.00118	0.00079

Grinding Across the Edge; as shown by Fig. 4; Width of Cut 0.028 In., Feed 11.5 ft. per Min.

Steel	High-Speed Steel	Alloy Tool Steel	Carbon Tool Steel
Maximum thickness, in....	0.00079	0.00315	0.00197
Standard thickness, in.....	0.00394	0.00197	0.00197



Figs. 3 and 4—Typical tools for which the standards of Table IV were established

Table III—Influence of Rate of Stock Removal on the Hardness of Cutting Edges (Grinding Crosswise)

Steel	Grinding Conditions: Depth, in.	Width, in.	Feed, ft. per min.	Brinell Hardness Before Grinding: Highest	Lowest	Average	Loss in Brinell Hardness: After grinding first side	After grinding second side	Average	Heat-Treatment
High-speed chromium-tungsten steels	0.0008	0.0286	11.2	906	895	895	22	...	48	Heated to 850 deg. C. cooled; heated to 1,300 deg. C. in gas furnace; cooled in air, drawn at 580 deg. C. in lead bath.
	0.0008	0.0286	11.2	918	884	895	...	74		
	0.0043	0.0286	11.2	906	884	889	11	...	16	
	0.0041	0.0286	11.2	873	862	862	...	21		
	0.0170	0.0146	11.2	...	...	906	...	140	117	
	0.0160	0.0276	11.2	884	873	878	94	...		
	0.0210	0.0146	11.2	906	884	895	77	...	95	
	0.0200	0.0276	11.2	...	...	884	...	114		
	0.0016	0.0276	11.2	862	831	846	10	...	25	Heated to 850 deg. C.; cooled; heated to 1,290 deg. C. in gas furnace; cooled in air; drawn at 580 deg. C. in lead bath.
	0.0024	0.0276	11.2	862	821	841	...	41		
	0.0063	0.0276	11.2	...	...	831	...	73	63	
	0.0079	0.0276	11.2	821	811	816	54	...		
	0.0114	0.0276	11.2	...	...	841	...	96	85	
	0.0110	0.0276	11.2	851	821	836	74	...		
	0.0024	0.0276	11.2	884	811	845	...	57	37	Heated to 850 deg. C.; cooled; heated to 1,290 deg. C. in gas furnace; cooled in air; drawn at 580 deg. C. in lead bath.
	0.0016	0.0276	11.2	831	811	821	17	...		
	0.0081	0.0276	11.2	841	831	836	...	108	85	
	0.0085	0.0276	11.2	821	802	809	61	...		
	0.0118	0.0276	11.2	851	831	841	83	...	89	
	0.0118	0.0276	11.2	841	821	831	...	94		
Alloy tool steels with 1.2 per cent tungsten	0.00039	0.0276	11.2	929	918	923	...	11	8	Heated to 200 deg. C.; cooled; heated to 750 deg. C. in gas furnace; quenched in water; drawn at 100 deg. C. in muffle furnace.
	0.00079	0.0276	11.2	...	...	918	6	...		
	0.0083	0.0276	11.2	990	977	990	134	...	215	
	0.0083	0.0276	11.2	952	940	952	...	296		
	0.0161	0.0276	11.2	1003	940	978	432	...	430	
	0.0161	0.0276	11.2	964	940	952	...	429		
Carbon tool steels	0.00079	0.0276	11.2	918	851	884	11	...	16	Heated to 200 deg. C.; cooled; heated to 780 deg. C. in gas furnace; quenched in water; drawn at 100 deg. C. in muffle furnace.
	0.00079	0.0276	11.2	918	906	912	...	22		
	0.0039	0.0276	11.2	918	895	906	65	...	98	
	0.0031	0.0276	11.2	918	906	912	...	132		
	0.0035	0.0276	11.2	929	831	880	...	156	140	
	0.0051	0.0276	11.2	...	...	831	123	...		
	0.0118	0.0276	11.2	851	841	846	...	270	230	
	0.0118	0.0276	11.2	873	862	868	190	...		

best grade blocks, it was decided to disregard a reduction in hardness of 35 to 40 Brinell numbers. On the basis of practical investigations, the rule was established that grinding must not reduce the hardness of high-speed steel tools by more than 75 to 80 Brinell numbers, and the hardness of carbon-steel tools by more than 60 to 65. Under these assumptions, Table IV was established giving maximum and standard depths of stock to be removed at one pass when grinding high-speed and carbon-steel tools. In this table are also given the width of stock to be removed and the corresponding feed.

It should be mentioned that the values given were obtained by grinding relatively bulky test blocks for which the most suitable grade was found to be Norton J-60 or similar. When grinding narrow lands and small surfaces it is more advantageous to use harder grades of grinding wheels. On that account when grinding small, delicate tools which have an insignificant dissipation of heat, it is imperative to reduce the feed and the surface speed of wheel if the depth of cut has to be maintained. Grinding should not be carried out in such a manner as to produce color on the cutting edges as this is a sure sign that the Brinell hardness has dropped more than 80 points, with serious loss of cutting qualities.

Molded Products and Their Manufacture

REPLACEMENT of metal parts by parts molded from synthetic resins has been progressing so rapidly that molded products have become highly important in the metal-working industry. Gears, handles, cases, inserts, panels and radio parts are some of the items regularly made from these resins. Beginning in an early number of the *American Machinist*, a series of articles will be presented describing the molding materials and the equipment and processes employed.

· THE · FOREMAN'S · ROUND · TABLE ·

The following narrative is a "case" presentation of the topic. It has been written to involve some of the questions that arise in the average shop. For guidance in preparing discussion the questions at the foot of the page have been prepared

Re-hiring Old Employees

"SAY, Al, I hear that Jack Thompson is coming back to your department to fill the job Bob Walker had before he quit. Any truth in it?" inquired Ed of his foreman friend.

"Yes," answered Al. "Why do you ask?"

"Well, since you and Thompson were in conference with Williams, from some 'outside' source a rumor to that effect has spread among the men in the shop."

"No harm in it, is there, Ed?" asked Al.

"Only that the men have been feeling uneasy about the situation. If you recall, Bill Wagner and Jack Thompson came here about the same time as helpers, and Jack had been promoted to a third-class rating just before he quit. Bill has stuck with the company, and now has a second-class rating. The men feel that either Bill Wagner, or one of the others who are eligible for the position, should be promoted."

"But, Ed, don't you think that Jack has gained a lot of experience in the three years he has been out in other shops? Anyway, Williams would have given him the job if he had stayed with us. What difference does it make because he quit? Jack is familiar with our line of work and with some other lines that he has learned since he left us, and so Williams has practically decided to hire him for Walker's job."

"Al, I think Williams is making a big mistake," blurted out Ed. "You're probably right that Jack would have been promoted to the job if he had stuck with the company. But he quit, while Bill and the others have stuck. The men have no personal grievance against Jack, but I think Williams would do better by promoting one of our own men, and hiring some stranger at a lower rating. Otherwise, he is going to break up the morale in the shop."

"Perhaps Williams thinks this is a good way to get new ideas into the shop, Ed. Jack was familiar with our work before he went away, and he ought to know how the outside ideas he has gathered will fit into this shop."

"But the others stuck, Al, don't forget that."

"I'm not. But the fact that Jack did break away may show the boss that he has more initiative than those who didn't. Many of the old shops used to send their apprentices away after they completed their term, and hire them back after a few years, better men in every way."

"Not much encouragement to stick, is it, Al?"

"Well, the prodigal son was taken back to his former job," grinned Al, "in spite of the man who had stayed faithfully on the job while he was gone."

Contributed by Morton Schwam

Was Al right about re-hiring old employees at higher ratings because of their experience in other lines of work? Or is Ed right that the men who have stayed with the company should receive first consideration?

All foremen are urged to discuss these questions vital to their work; of course the

discussion is not limited to foremen. Letters accepted and published will be paid for

Discussion of Earlier Topics

Shall a Man Sit Down to Work?

THE company by whom I am now employed makes it a hard and fast rule to place a chair or stool at every machine or bench position, regardless of whether the employee can use it or not. Thus when a person becomes tired from the strain of maintaining a certain position for a period of time, he is able to rest for a few moments. We also make it a point when purchasing chairs, to get the best obtainable, fitted to the person and the job, with the result that since starting this practice we have increased our production upward of twenty per cent.

A case occurred about six months ago, where a number of benches were installed on which were small machines, requiring the women operators to bend forward at short intervals, thus tiring them in a short time. We made a study of the operation and finally designed a chair which would swivel, and swing forward similar to a well built rocker. —FRED AUG. SCHMIDT.

The Foremen's Ideas on Pensions

I AM opposed to anything given in the nature of a pension; it savors too much of the down-and-out. An industrious man at sixty can and should be independent, but after a long and faithful service with one company, a "dividend" based on services rendered would be most acceptable and appropriate. Time served might be considered the equivalent of cash invested in stock, and an income from such a source, and so considered, would be a real boost in his declining years. A pension, never!

—C. D. MICHENER.

Letting Small Savings Offset Larger Wastes

I WOULD certainly vote a rousing cheer to that shop which Ed has heard about, for its courage in breaking away from the "petty cash accounting system" in the shop. Of course, the advocates of elaborately minute record systems can always show figures which sustain their viewpoint, but anyone who has had any real experience in creating statistics knows that you can usually make them up to prove almost anything you set out to establish. The real difficulty is that the advocates of this kind of saving never charge off the costs of their operation against the apparent saving they report.

In the first place, the men naturally resent this petty checking up, so consequently they make every effort to beat the system and accumulate a private hoard of small tools and drills, against the time when they may need it to square themselves. Here is a real waste in itself, not to count the time spent searching for a misplaced or lost drill or that spent in a borrowing visit around the shop for one if it is not found. The men take these records seriously, but only in that they'll square their record somehow, no matter what the cost may be in lost time. —JOHN F. HORRISBERGER.

THE · NEXT · TOPIC

Going Over the Super's Head

ADVANCE QUESTION

Ed tells of a friend who went to the general superintendent over the super's head—and what happened. Al thinks it may be justified, but that it is a ticklish thing to do. What do you think?

Gang Bonus in the Shop

THE group bonus plan may have possibilities, but it seems to me to be too one-sided. Some of the workmen are content to do as little mental and physical work as the boss will let them; therefore they should not benefit by sharing in any bonus created as a result of some fellow workman's thought or effort that enables him to produce more. Where two or more men are working on exactly the same operation or sequence of assemblies, it seems to be quite fair to place them in one group and pay each man his share of the total bonus.

In our plant we have one group composed of three men, two of whom make two entirely different assemblies each, and the third works continually on another one. If one of these men runs into a little "tough luck" and loses an hour or two, it kills the bonus for the other two, since the group production falling down pulls the group bonus lower. This does not look fair to me, as these five assemblies are quite different and none of the men are familiar with the work of the others and could not help them out if he wished.

—L. O. BROWN.

More Responsibilities for the Foreman

ALL new fixtures, first pieces, and smudgy blueprints should be submitted to the foreman or sub-foreman, especially in shops where there is no system of inspection. When a man is sure that his first piece is O.K., he will be able to devote his whole energy to production, and many costly blunders will be avoided. With all errors corrected at their source, the stream of production should, and will, flow freely. —ROBERT S. ALEXANDER.

Mass Production in Assembling Planes

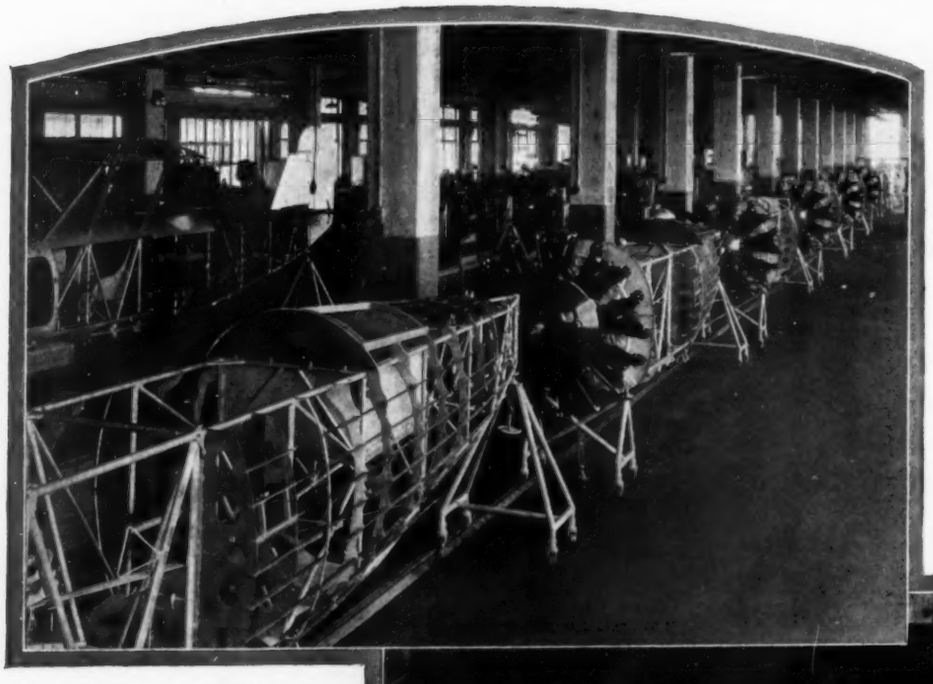


Fig. 1—Assembly department in the Vought factory showing the production line

Fig. 2—Fuselage of the new Fairchild, two-place, low-wing monoplane at the start of the assembly. Steel tubing is used in the fuselage, "Alclad" metal in the tail surfaces

Photographs by courtesy of Chance Vought Corporation and Fairchild Aircraft Corporation

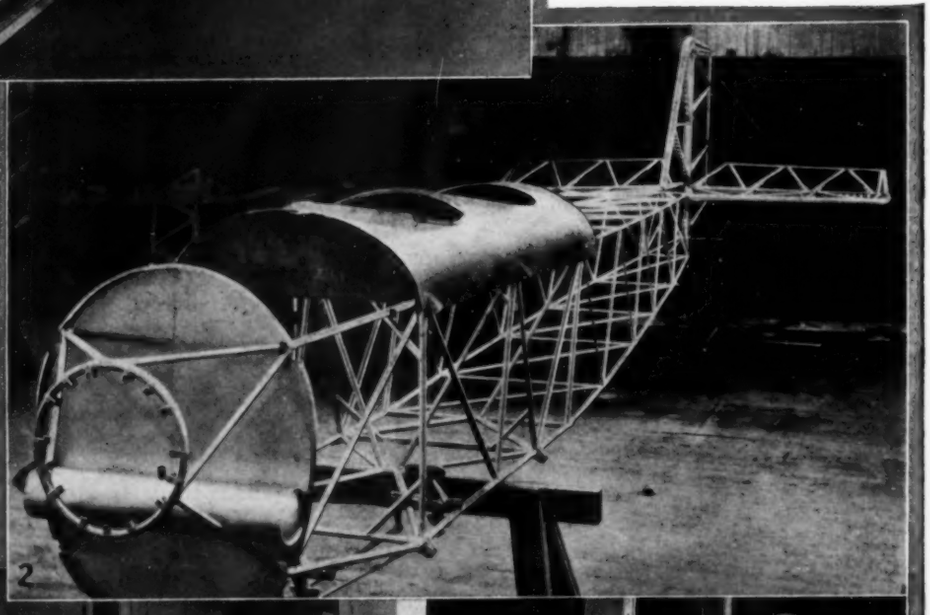


Fig. 3—Final assembly of the Vought planes for the U. S. Navy. The stands with casters and guide tracks aid progressive assembly

Centralized Records for Efficient Tool Control

By N. J. Bowne and N. Holve
De Laval Separator Company

Completion of the method of issuing the order—More of the forms, and the sequence in which they are filled out

When the foreman wrote his requisition for the two mandrels, he used the equipment-requisition form shown at F7, Fig. 10. The tool shop-order, F8, was typed as original with duplicating ribbon, together with two copies of the tool design-order, F9, and one copy of the tool manufacturing-order, F3. At this time the master tool-record, F1, was typed. This record is filed in the Kardex master tool-record file, according to tool number 522143, thus automatically placing its record with the records of all other mandrels of similar sizes. A permanent green signal is placed over the word "Design," thus showing at a glance that an order for this tool is in the designing division.

The equipment requisition, with the tool shop-order, is filed according to requisition number 14C-2, as that is the only number the foreman is familiar with should he desire to make an inquiry at this point. The tool manufacturing-order and one copy of the tool design-order are given to the tool engineer. The other copy of the tool design-order is sent to the tabulating division of the cost department as a notification that order 522143-1 has been issued.

The tool engineer keeps the tool manufacturing-order in his order file and gives the tool design-order to the draftsman to whom he assigns this work. The tool design-order is placed in a holder on the designer's board, so that his superior can at any time see what he is working on and how much time he is spending, as he each day enters the time spent on this order from his time card before it is sent to the pay-roll department. When the design has been completed, the designer fills in the drawing-finished date and the drawing number, which in this case is the same as the tool number. The drawing is checked with the order and is referred to the tool engineer for approval. A blueprint is ordered and the drawing is filed, according to number, in the drawing vault.

The blueprint, the tool design-order and the tool manufacturing-order are referred to the tool estimator for the detailed estimate and the layout. He gives the material specification on the tool design-order, with the main material on the top part and the details on the bottom part, or on the back if necessary. On the tool manufacturing-order he fills in a complete layout, the due date, the drawing number and the main material. This order and the tool design-order are signed by the estimator, and with the blueprint, are referred to the tool-record supervisor who signs for "Shop-Order Issued," and attaches the equipment requisition and the tool shop-

The third part of the article. The conclusion will appear in an early issue.

Fig. 9—One corner of the tool-record division. In this department, tools are designed by an efficient corps of tool designers. The stock and accounting records for more than 10,000 tools are made out here and are kept in the Kardex filing cabinets

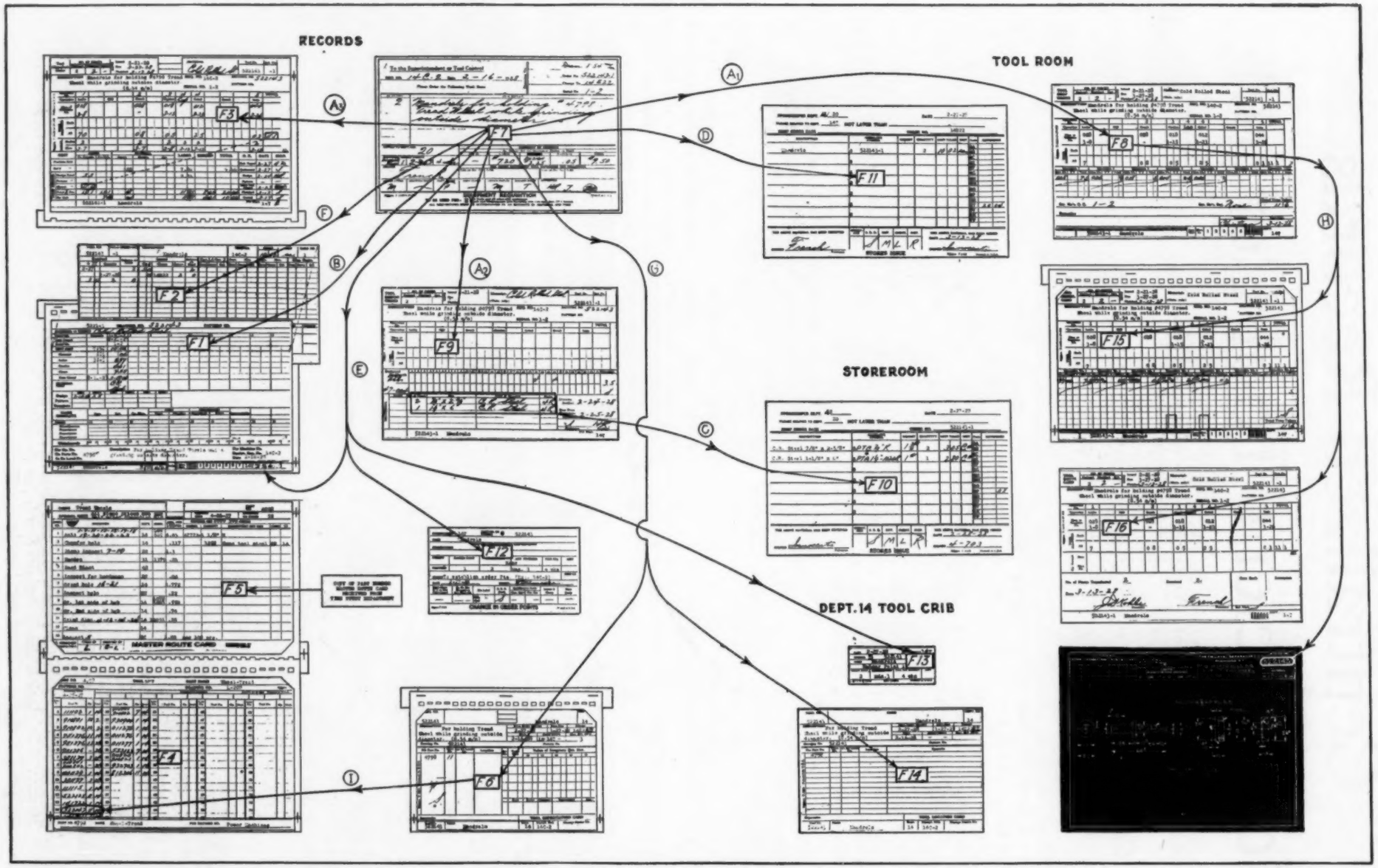


Fig. 10 — Some of the forms used in issuing orders for tools and in keeping track of them during the progress of manufacture, together with their cost and location. F1—Master tool-record. F2—Balance card. F3—Tool manufacturing-order. F4—Tool list. F5—Part route-card. F6—Depreciation card. F7—Equipment requisition. F8—Tool shop-order. F9—Tool design-order. F10—Material issue. F11—Tool issue. F12—Change in order-point slip. F13—Bin label. F14—Location card. F15 — Tool progress-card. F16—Tool route-card. In the lower right-hand corner is the blueprint of the tool to be made. The lettered lines, together with the arrow points, show the sequence in which certain entries are made on the various forms used to keep track of the tools

order from the file. He also fills in the proper charge number on the equipment requisition and forwards the documents to the typist. The typist makes out stores issues, F10, in duplicate as per material details on the tool design-order.

The original is sent direct to storeroom 4R, and the duplicate to the toolroom, department 20, as notification that the material and the order will be received.

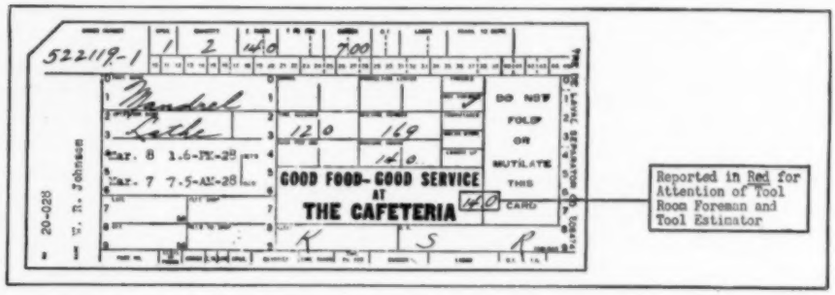


Fig. 11—The time card employed under the system

The due date and the complete layout, as per tool manufacturing-order, is typed with duplicating ribbon on the tool shop-order. The stores issue for the completed tools is now typed, showing the charge number, 14E22. As order points are suggested, a change in order-point slip, together with a buff bin-label and a buff order-point tab, is typed for the master tool-record. Buff is used for manufactured tools and blue is used for purchased tools.

Finally, the location card, F14, and the depreciation card, F6, with the former as original, are typed with information taken from the equipment requisition. From the tool shop-order, two additional forms, the tool progress-card and the tool route-card, F15 and F16, are copied on a "Ditto" machine, as they so far contain exactly the same information as the tool shop-order. These three forms, together with the blueprint and the tool issue, F11, are sent to the toolroom where the tools will be manufactured as per the order and the print.

The location card and the bin label, F13, are sent to the toolcrib in department 14 as a notification that the tools ordered by it on requisition 14C-2 are actually started and will be delivered not later than the date specified. The toolcrib attendant files the location card in a tickler file under the due date. The bin label is placed on the bin that has been provided for these tools in the crib. The tool designing-order, the tool manufacturing-order, the tool balance-card, F2, the tool depreciation card and the order-point tab are referred to the balance clerk.

From the tool manufacturing-order and the tool designing-order are entered in ink on the master tool-record, the drawing number, the material and the time for the design. The tool design-order has now fulfilled its purpose and is filed in a folder in which all data connected with this order is collected. The tool manufacturing-order is filed in the back of the previous pocket in the Kardex file, as the record of tool order in process. The tool balance-card and the order-point tab are filed in the same pocket as the master tool-record, and the permanent signal is moved over "Shop order issued." A temporary pink signal is placed over the due date. The temporary signals are orange for January, April, July and October; green for February, May, August and November; and pink for March, June, September and December.

Now we have a complete record of all data up to this point regarding the tool order in one place, with all the important information visible. The tool depreciation-card is checked against the master tool-record and is cross indexed in the part-number cross index. The tool number is entered on the first available line on the tool list, F4, in this case line 14, there are also entered the operation and the department numbers. The line number, 14, is entered on the corresponding operation number on the route card, thus establishing the cross index.

The change in order-point slip, F12, is referred to the tool-record supervisor for approval, and is filed in back of, and in the same pocket as, the master tool record. As mentioned above, the duplicate material issue, the tool shop-order, the tool progress-card, the tool route-card, the blueprint and the issue card for the tools are sent to the toolroom. When the material is received, the tool route-card and the duplicate material-issue are inserted in a transparent envelope and placed with the material, which together with the shop order and the blueprint, are delivered to the sub-foreman where the work is to be done. He keeps the tool shop-order in his order file until the work has been completed. The envelope, the blueprint and the material are given to the toolmaker who, according to the layout of the order, is assigned to perform the first operation.

The tool progress-card and the issue for the tool are filed in a Kardex file in the tool department, after buff tabs have been placed in the man record, and a permanent green-signal in the Kardex file placed over "Material issued," and a temporary pink-signal placed on the due date. When the toolmaker starts work on this order, a time card, Fig. 11, is made out by the tool-department clerk, stamped with the starting time and given to the man. A white tab showing the order number and the time started is inserted in the man record. When the work has been finished, the man leaves his card at the time clerk's desk. The time taken is computed, the tabs in the man record are removed and the information is posted on the tool progress-card, in the space for the first operation. The permanent signal is placed over "Operation 1," thus showing at a glance that the first operation has been completed.

The shop clerk enters the time allowed on the time card. If the time taken exceeds the time allowed on any operation, the time taken is entered with a colored pencil on the time card, thus bringing to the attention of the proper man that the time allowed has been exceeded and that especial attention is necessary to see that the other operations are kept within the estimated time. When the time taken exceeds the time allowed by certain limits, it is reported to the estimator who then has an opportunity to look into the situation with the toolroom foreman, and very often several hours of inefficient labor may be saved. This action is based on the following schedule:

(A) Operations with time allowed of from ten to fifty hours are reported in:

1. Blue—for attention of toolroom foreman.
   a. When on incompleted operations the time taken exceeds the time allowed, up to 10 per cent.
   b. When on completed operations the time taken exceeds the time allowed by from 10 to 25 per cent.

2. Red—for attention of the toolroom foreman and the tool estimator.
   a. When on incomplete operations the time taken exceeds the time allowed by 10 per cent or more.
   b. When on completed operations the total time taken exceeds the time allowed by 25 per cent or more.

(B) Operations having a time allowance of 50 hours or more are reported in yellow, for the attention of the toolroom foreman, when 75 per cent of the time allowed is taken, and from then on as per *A*.

(C) Operations having a time allowance of 10 hours are reported only when the time allowance is exceeded by 50 per cent, in which few cases procedure *A* is followed.

After the time cards have been approved by the toolroom foreman, they are sent to the tool records. All cards for completed operations are entered in the tool manufacturing-order in the master file, with the number of pieces finished and the date. The permanent signal is moved accordingly. Thus we know the progress of this order in the toolroom, each day, without any special report being furnished. This gives an efficient check to see that the due date will be met. Any delay is always signalled in the file and is reported to the toolroom foreman, or to the tool supervisor, if no action is taken after the first report.

After the last operation has been completed, the tools are checked by the tool inspector, who enters his report on the tool shop-order. The clerk then fills in the quantity and the finished date on the tool route-card and sends it with the tool issue and the two mandrels to department 14-toolcrib. The tool progress-card is removed from the Kardex file. The total time taken is computed and the time taken for each operation is entered on the tool shop-order, which is referred to the foreman for approval and is later filed by the tool number as a permanent record in the toolroom. This document and the blueprint are the only permanent records kept in the toolroom, but they give practically every detail of interest to the toolroom foreman.

The tool progress-card is sent to the tool records. The total time, the finished quantity and the date are entered on the tool manufacturing-order, and a permanent signal is placed over "Location." The temporary signal is removed. Now we know that the tools have been finished and are on their way to department 14. We also know how much time was spent in the toolroom, which time is compared with the estimator's original figures. After the estimator has seen and compared the result, the tool progress-card is filed in the folder, its purpose having been fulfilled. In the meantime, the material issue has been entered on the material balance-card; priced, extended, gone through the distribution and is finally filed in the folder.

When the tools are received in department 14, the foreman or his delegate approves the tools by signing the tool route-card. He also approves the charge number by signing the tool issue. The tool location-card is removed from the tickler file and is filed in the toolcrib file, after the location has been entered by the toolcrib attendant. The tool route-card and the tool issue are returned to the tool records. An entry is made on the balance card from the tool route-card, deducting from the balance on order and adding to the balance on hand. The tool issue is deducted from the balance on hand and added to the balance in department 14. The permanent signal is now moved to the extreme right-hand corner, as all documents have been entered.

The issue, however, can not be sent to the accounting department until it is priced, therefore, it is filed in back of the balance card until the cost has been determined. When the tool route-card is filed in the folder, it is removed from the open-order file. All documents are checked, and if they are all in the folder, the order is "closed," which means that the tool manufacturing-order is removed from the Kardex file and sent to the cost department to be costed. Tabulating machines are used for payroll and other purposes, including the compiling of tool costs. The following details are tabulated on the tool manufacturing-order: Hours, material, labor, burden and total, both for the total quantity of the tools made and for each one of the tools.

When the tool manufacturing-order is returned to the tool control, the total is entered on a report of closed-tool orders, which report is submitted to the accounting department at the end of each month. The unit cost of the order is entered from the tool manufacturing-order on the master tool-record in detail, thus permitting a comparison with the estimate and future orders. The total is also entered on the balance card. The tool issue, filed in back of the balance card, is removed, priced and sent to the cost department for distribution. The tool manufacturing-order is referred to the tool engineer, and when the estimate has been exceeded by 25 per cent or more, to the tool supervisor. The tool engineer now has a complete picture of the procedure of the order and can investigate any questionable point while all the details are fresh in the minds of everyone concerned.

The tool manufacturing-order is finally checked by the tool-record supervisor and is filed in a folder for future reference. If these mandrels had been made for "plant," the tool cost would have been entered on a tool-depreciation card, for inventory purposes.

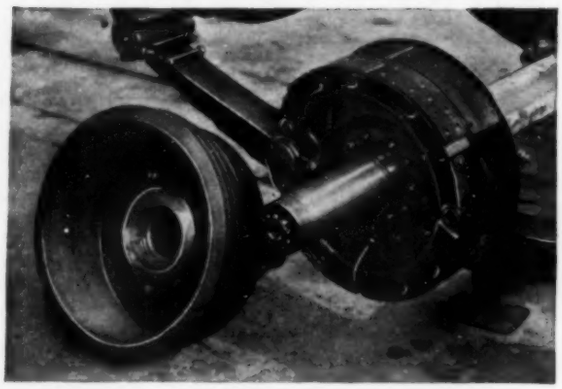
Now we have a complete record regarding these mandrels in the master tool-record file, with more detailed data compiled in the folder, which is kept indefinitely on initial orders.

The master tool-record has a capacity of nine orders, which is sufficient for several years, as an average of two orders a year are placed for the same tool.

Twenty-two Miles of Rope Brace New Dirigible

THE 28 years that have elapsed since Count Zeppelin launched his first rigid airship have seen great changes. The huge British ship R-100 is due to visit us in April or May and then go into regular service between London, Egypt and India. While 67-ft. shorter than the Graf Zeppelin, it is 133 ft. in diameter, as against 100, and has a gas capacity of 5,000,000 cu.ft. as against 3,500,000, which increases the carrying capacity to 100 passengers, a crew of 40 and space for 10 tons of mail or freight.

It is no small job to brace a frame work ring of 133 ft. diameter, this being done by wire rope of various sizes and length. Over 22 miles of this rope is used, being supplied, incidentally, by the Scotch licensee of the American Cable Company. There are six Rolls-Royce Condor engines of 700-hp. each, giving a cruising radius of 4,000 to 5,000 miles at 80 miles per hour.



Lancia Method of Machining Brake Shoes

A recognition of the importance of brakes is reflected in the accuracy of the various operations

By J. A. Lucas

USING the same highway with private cars, a five-ton passenger bus must be governed by the same rules, and come to a standstill from any given speed as quickly as the smaller car. Its greater weight cannot be urged as an excuse for its failure to stop, as the answer to such a plea would be a reduction in the speed it would be allowed to travel. Good brakes, therefore, make the high-speed passenger bus practical.

Though brakes are of little interest from the shop point of view, it is evident that the Lancia company's engineers understand their importance. The tooling methods show that, although the output is only four brakes a day, they appreciate the fact that a good brake must have accurate parts, and the whole layout tends toward accuracy rather than toward cheap production. The fixtures in some cases are such as would be used for many times the scheduled output. That this is the result of planned study, and not merely extravagant tool designing, is made plain by comparison with the tools used for the Lancia passenger car brakes, which were described on page 623, Vol. 68, of the *American Machinist*.

An assembled rear wheel brake unit, with its ribbed drum, presents a workman-like appearance, as can be seen in the headpiece. The use of a ribbed drum to dissipate heat seems to be confined to European practice. In this country where the brake drums are drawn instead of cast ribbing is not considered necessary.

The operation sheets for the brake shoe show 19 operations, of which the most important are indicated by the sketches shown in Fig. 1 below.

The shoes are made of malleable iron, and as they are usually warped when received from the foundry, they are straightened, filed, and visually inspected before being sent to stores. The first shop operation is to layout. This is done on a fixture built for the purpose. The controlling factor in the machining of the shoe is the thickness of the curvature of the face to which the brake band is riveted. The inner diameter of the web is not finished and some means of maintaining the proper thickness of the band face, without changing the outside diameter, must be resorted to. If the rough inner surface of the shoe were clamped to the semi-circular block of the fixture shown in Fig. 2, and the segment of a circle scribed by means of the swinging arm, the thickness of the shoes would be uniform, but the thickness of the band faces would vary. To avoid this, the thickness gage shown at *C* is used to scribe three short lines at as many points on the edge of the band face.

The shoe is then clamped to the fixture and the finish line is marked by the scriber in the swinging arm. This line must coincide with the three short ones previously scribed. The two blocks *A* and *B* are adjustable to allow of manipulating the shoe so that this scribing can be done. The semi-circular cam face at the expansion end, and the hole for the bell crank hub, are laid out at the same time by the attachments *D* and *E* shown in the same illustration.

The drilling and reaming of the hinge, bell crank, and hinge pin holes are shown in Fig. 3, and a close-up of the same fixture, Fig. 4, shows how the piece is registered from the line previously scribed by the swinging arm. The shoe is manipulated by the adjusting screws *B* until the indicators *A* (one not shown) register, on the

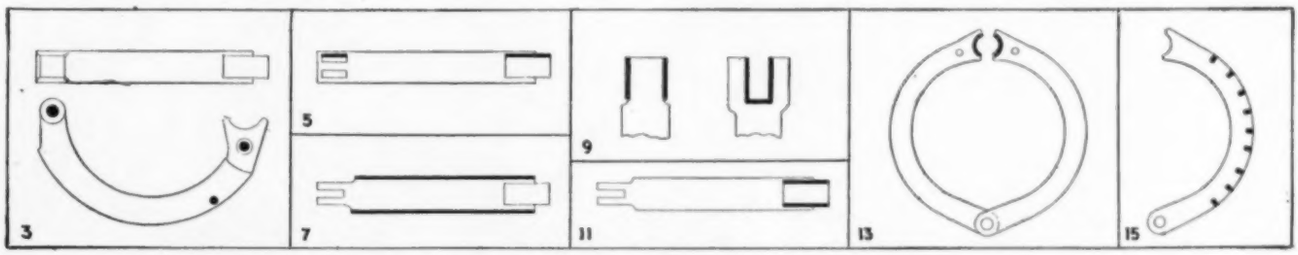


Fig. 1—The diagrams show the principal operations. The sequence of operation is shown below

3. Drilling, reaming and spot-facing 3 holes
5. Facing spring, and spring pin supports
7. Turning outside diameter and facing ends
9. Milling hinge members
11. Straddle facing cam face for clearance
13. Boring clearance for cam
15. Drilling rivet and spring bolt holes

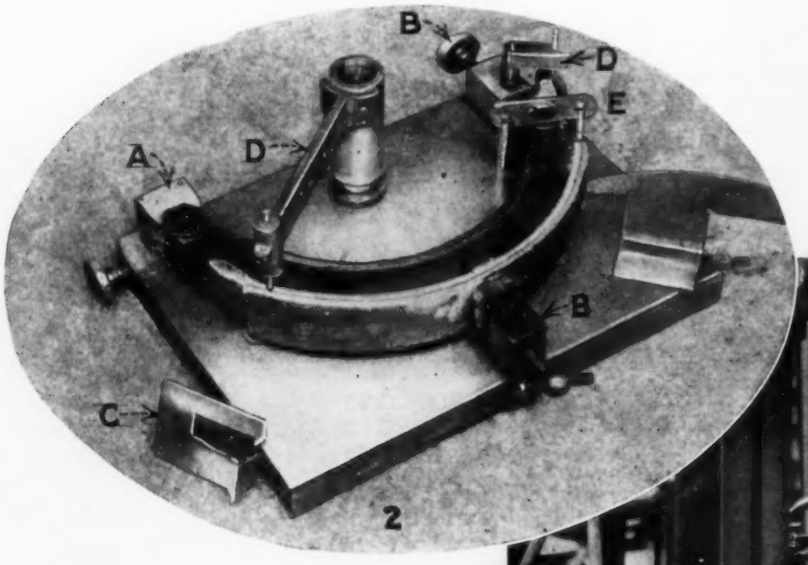


Fig. 2—Fixture for laying out and scribing the minimum thickness of the band face, the cam clearance, and the bell-crank hub hole

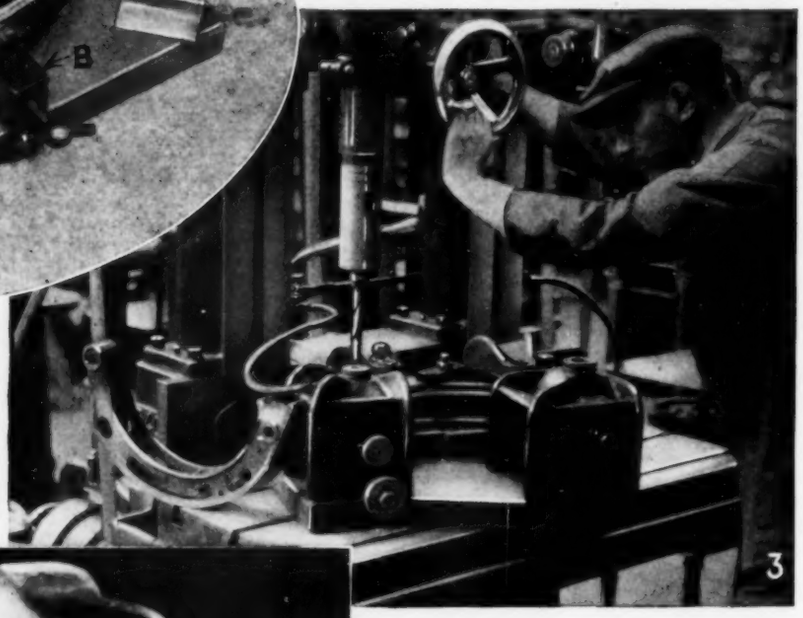
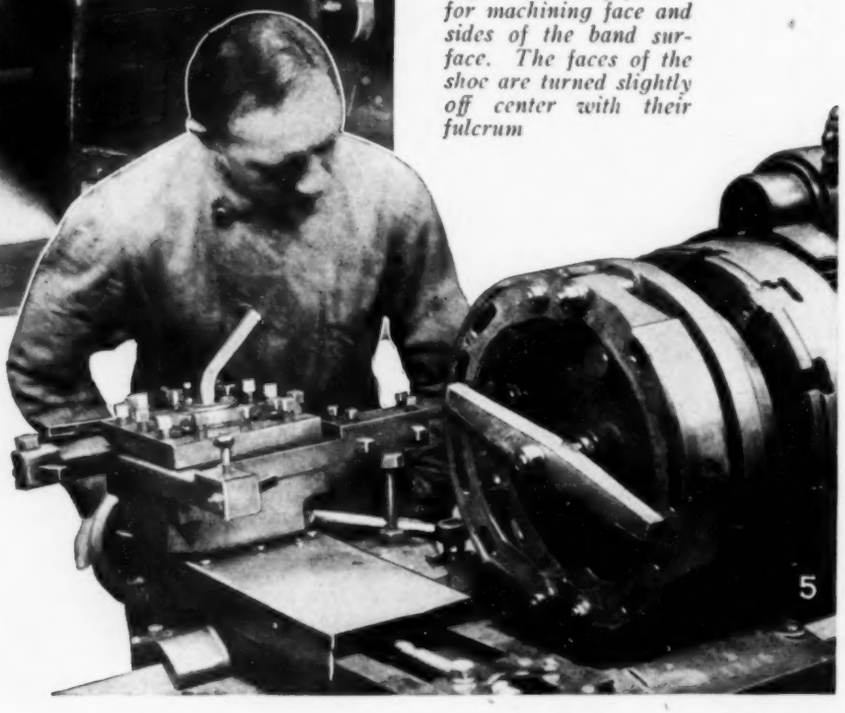


Fig. 3 — Drilling the hinge, bell-crank, and hinge pin holes

Fig. 4—A close-up of the jig used in Fig. 3 showing how the drilling operation is registered from the line scribed in the layout fixture

Fig. 5—Turning fixture for machining face and sides of the band surface. The faces of the shoe are turned slightly off center with their fulcrum



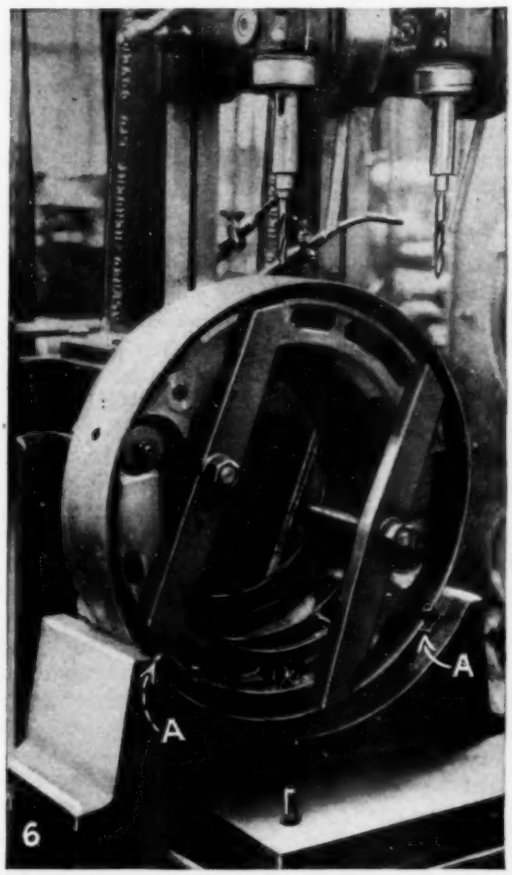
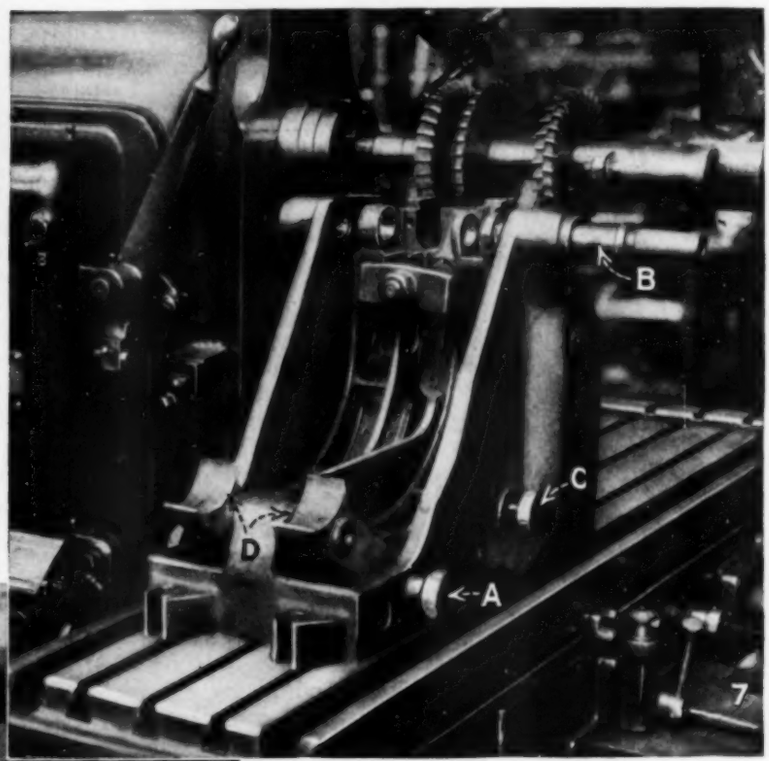


Fig. 6—Revolving drill jig and movable saddle for drilling rivet and bolt holes

Fig. 7—Milling hinge members of two mating parts. One end is slotted, the other straddle milled

Fig. 9—Boring the cam surfaces in an upright drill. The clamp has been removed to show the operation more clearly



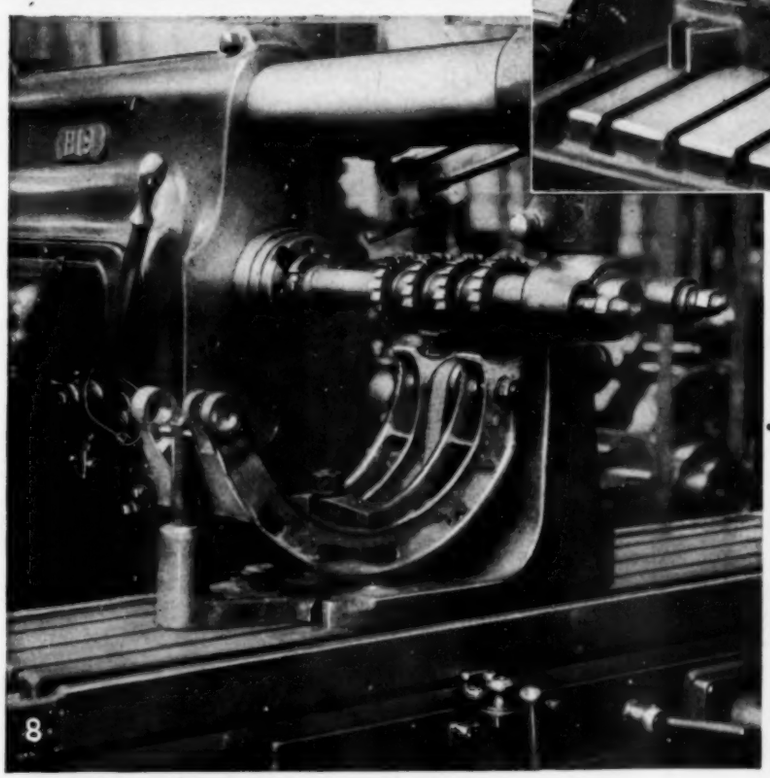


Fig. 8—Straddle milling the cam surfaces for side clearance

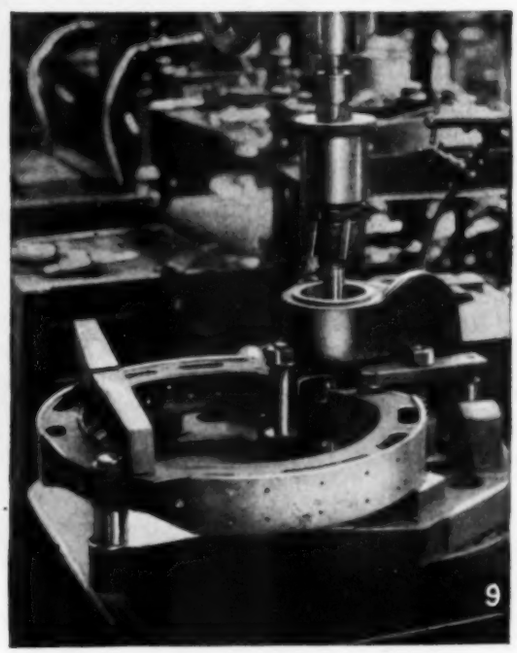


Fig. 10—As the pivot end floats it is necessary that the band faces be slightly elliptic in reference to it. The swinging arm and taper gage show this

scribed line. The shoe is then clamped in place and drilled.

These holes are used in all subsequent machining operations for registration purposes. The first of these is shown in Fig. 5 where a turning fixture is centered in the spindle of a lathe and is held by the chuck jaws. In this fixture the studs that engage the hinge holes are shifted so as to throw the band face slightly eccentric, so that when mounted on the axle housing the two half circles are slightly off center, thus tending to bring the maximum amount of brake surface into contact with the drum with the least pressure. The tolerance on this operation is plus or minus 0.004 inch.

A simple, yet effective, combination jig and fixture is used for drilling the rivet and bolt holes in the band face of the shoe. A two-spindle drill press is used. In one spindle is a drill for the bolt holes, and in the other spindle one for rivet holes. The fixture is held central (crosswise) with the two drills by a key, which is free to slide in the slot in the table. The bolt holes are drilled first by revolving the ring, then the fixture is moved to the left under the rivet hole drill. As set, in Fig. 6, it is for the central row, when this is finished the stop pins at *A* are moved to adjacent holes and the ring moved sidewise and again revolved in its saddle. The operation is repeated for the third row of holes.

In the milling operation shown in Fig. 7 the mating hinges are milled, one being slotted, the other straddle milled. In setting up the two shoes the bell crank holes are registered on ground pins. A removable plug *A* is then inserted in the hinge holes. The adjusting screws *A* and *C* are tightened and the two shoes clamped securely. The clamping must be done in a manner that permits the removal of the plug *B* without trouble.

Straddle milling the semi-circular cam surface at the expansion end is done in the same machine. This is not a very accurate job, so the method of registering is simple. In this operation, shown in Fig. 8, the table is fed upward against the cutters.

The finishing of the cam face is done in an upright drill, using an end mill guided rigidly. This fixture is shown in Fig. 9 with the clamping bar removed to show the operation clearly. The type of water guard used on the drill presses is also shown.

After the various machine operations have been performed on the piece, it goes to the final inspection bench. The hinge of the shoe is placed on a ground pin, and the other end against a circular block. A swinging arm with a pendant gage is free to move around the face. A graduated taper wedge is used to determine whether the circular face has the proper degree of eccentricity.

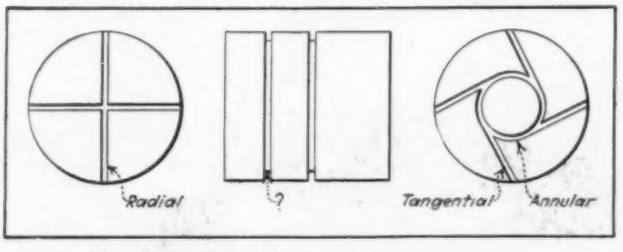
Following this inspection, the parts are assembled. The illustration at the beginning of the article shows that the two shoes are assembled on a hollow hinge pin held in place with a set screw. This hinge pin is not attached to any other part, and, therefore, the two shoes are free to float. Two sheet-metal springs hold them flexibly in place and away from the drum. When the brake is applied the two shoes center themselves with the drum instead of merely expanding on a fixed hinge.

Another distinctive feature of this brake is the use of both cams and bell cranks for expanding. It is a well established fact that an emergency brake cannot be used in an emergency, and is therefore useful only for parking purposes. The Lancia company recognizes this, but sees no reason for an idle brake. Both of the brake bands are therefore expanded by butterfly cams, as a service brake. The emergency brake lever is connected by a link to the bell cranks and while normally inoperative, it can be used for emergency, or to supplement the pressure of the foot brake.

What is a Slot?—*Discussion*

By E. R. Plaisted
Lane Manufacturing Company

REFERRING to the discussion on "radial" and "annular" grooves on page 202, Vol. 70, of the *American Machinist,* the sketch illustrates a solid cylinder on which I have shown what I understand to be "radial" grooves, "annular" grooves, and "tangential" grooves. I have also shown the groove referred to in your article,



How shall we designate slots and grooves?

but it is difficult to find a single word that will describe it so no one can misunderstand.

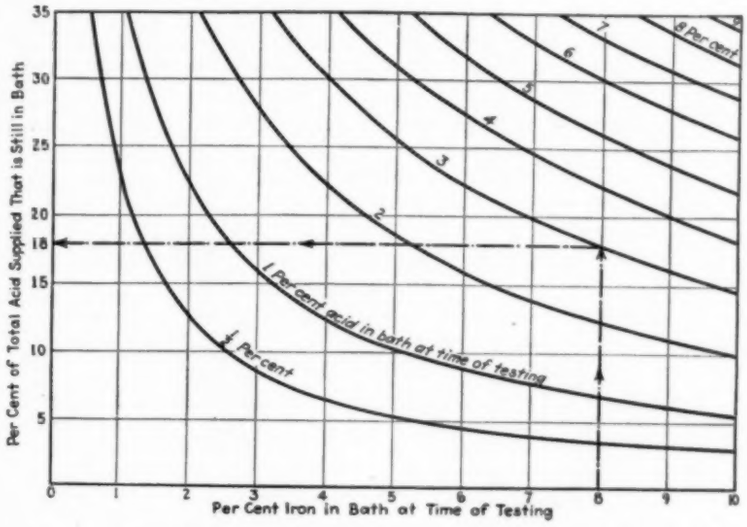
Annular grooves are "circular," but they cannot be cut on any part of a solid cylinder except its end. "Circular" grooves might be cut on the end or side walls of a cylinder, therefore the term "circular" is insufficient. If a man at a lathe were told to cut "piston-ring grooves" in such a cylinder he would understand perfectly. Furthermore, if he were told to "neck" a groove $\frac{3}{8}$ in. wide and $\frac{1}{2}$ in. deep in a piece of shafting or a piston head he would undoubtedly have no trouble in understanding what was wanted. If there is any other *one* word in the dictionary that would describe this sort of groove better than the term "neck" I would like to learn of it.

Pickling Practice and Theory

How to Test the Bath
How the Scale Is Removed

By W. H. SHIPMAN
Associate Editor, American Machinist

"WHEN my bath works too slowly, I pour in acid until it speeds up again, and once a week I throw it all away," is one way of running a pickling bath. Another plan is to use the bath as long as it "tastes" strong. A hydrometer is useless as the iron salts pile up in the bath and increase its specific gravity. The above methods are mostly guesswork, and of course, if the operator does not guess correctly as to the most economical point at which to throw away the bath, either productive time or acid is wasted. The best way is to *know* when to add acid, and when to dump the bath. The accompanying figure shows the per cent acid lost under various conditions for a sulphuric bath used to pickle iron and steel. Supposing that 100 lb. of acid were used in making up a fresh bath, and that a total of another 100 lb. was added during the life of the bath. If the bath contains 3 per cent of acid and 8 per cent of iron at the time of dumping, then, from the figure 18 per cent (36 lb.) of the total acid used never did any useful work, but was thrown away at the time of dumping the bath. If the bath were used down to 1 per cent acid and 9 per cent iron, this loss would be reduced to about 6 per cent. Of course, the saving in acid is accomplished at the expense of production time, and the two factors have to be balanced.



The example shows that 18 per cent of the total acid supplied to the original bath and by additions, would be lost if the bath were dumped when it tested 8 per cent iron and 3 per cent acid

Various methods have been developed for testing the strength of the pickling bath once or twice a day, so that it may be kept at its maximum economical strength without waste. In some methods, a small but definite amount of the bath is placed in a convenient acid-resisting container and special capsules, pills, or testing solutions added to this sample until there is a change of color. The number of pills or capsules required to produce this change of color, or the change in level of the solution in a testing tube, represents the acidity of the bath in per cent so that no calculations are required. Another kind of pill or solution is used to indicate the iron content, and still others are made for solutions other than sulphuric acid.

It is good practice to keep the acid concentration approximately constant by additions of acid until the bath becomes heavy with iron, and then "kill" the bath. "Killing" consists of reducing the acid content of the bath, preparatory to dumping, by stopping the additions of acid and raising the temperature gradually to the maximum.

It is common practice to throw away the bath solution when the iron content has reached 6 to 15 per cent, with about 8 per cent as average practice in the enameling industry, the percentage for other work depending upon such factors as the condition of the surface of the work necessary for succeeding operations. It is always customary to dump before the salt starts to crystallize out on the walls of the tanks, as it is otherwise difficult to clean the tank. Temperature has a greater effect on the rate of pickling than does strength of acid. For example, increasing the temperature from 150 to 180 deg. F., will approximately double the rate, whereas the acid strength must be increased from, say, 5 to 15 per cent at these temperatures to produce the same effect. Therefore, it is important to watch the temperature of the bath, and some plants do this at frequent intervals during the day by means of an ordinary thermometer.

When pickling acids are dissolved in water, a portion of the acid molecules dissociate, or separate, into two or more electrically-charged parts called ions. The solution, as a whole, of course, remains electrically neutral, and the water undergoes no chemical change but merely serves as a piece of apparatus in the process. This breaking up into ions is called ionization. The effect on pickling acids is as follows:

$$HCl = H^+ + Cl^-$$
$$H_2SO_4 = H^+ + HSO_4^- = H^+ + H^+ + SO_4^{--}$$
$$HNO_3 = H^+ + NO_3^-$$
$$HF = H^+ + F^-$$

Conclusion of the article.

That is, hydrochloric acid (HCl) forms a positive hydrogen ion and a negative chlorine ion; sulphuric acid forms first a positive hydrogen ion (H), and a negative hydrosulphate (HSO_4) ion and then two positive hydrogen ions and a sulphate (SO_4) ion with two negative charges.

The acidity of the pickling bath depends largely upon the concentration of the positively-charged hydrogen ions in the bath. When we say an acid is strong, we are also saying that it ionizes rather completely. The extent of the ionization varies with a number of factors. Thus, some acids ionize more completely than others, and the greater the dilution of pickling acids with water, the the greater the extent of the ionization. Increase in temperature also increases the percentage of ionization, as well as decreasing the viscosity and, therefore, the resistance to the motion of the ions. With very weak baths, the time of pickling is long, and with baths much stronger than used in practice, the time again becomes long. The reason for this is that the effective strength of the bath depends upon the product of the per cent of acid in the bath, and the per cent of ionization. The ionization is high in very dilute solutions, but the per cent of acid is low, and so the product is low. The tests shown in Figs. 1, 2 and 3 of the first part of this article indicate that the product is greatest at 15 to 25 per cent for cold sulphuric acid, and at 5 to 40 per cent for sulphuric acid at 180 deg. Fahrenheit.

Misconceptions as to what goes on in pickling can be cleared up by an understanding of pickling theory. This description offers the fundamentals of the subject in a practical manner as an aid in modernizing pickling practice and equipment

The whole basis of the pickling action is the displacement of the positively-charged hydrogen ion by the metals being pickled. If there is no hydrogen evolution, there is little pickling. The following list shows the relative activity of various metals in displacing the hydrogen ions. All metals before hydrogen in this list displace hydrogen from the pickling bath while those after it do not. Those highest in the list are the most active: aluminum, manganese, zinc, chromium, iron, nickel, lead, tin, *hydrogen*, copper, silver, platinum, gold. The reactions with pure iron are as follows:

$$H_2SO_4 + Fe = FeSO_4 + H_2\uparrow$$
$$2HCl + Fe = FeCl_2 + H_2\uparrow$$

The arrow indicates that the hydrogen is given off as a gas.

So far we have discussed only pure metals. While we say that the acid "eats" the scale in pickling, the truth is that iron rust and scale are rather insoluble in pickling acids. Iron rust consists mainly of a hydrated ferric oxide, $3Fe_2O_3, H_2O$ which is porous, brittle and adheres loosely to the steel. Hammer and rolling mill scale are the same as magnetic oxide of iron, Fe_3O_4, and are more insoluble than rust. The acids penetrate in, around, and under rust and scale, the hydrogen ion being displaced by the pure iron underneath the scale, and the hydrogen being set free. The evolution of the hydrogen exerts a prying action on the scale; thus the removal is mechanical as well as chemical. The reactions are approximately as follows:

$$Fe_3O_4 + 4H_2SO_4 = FeSO_4 + Fe_2(SO_4)_3 + 4H_2O$$
$$Fe_3O_4 + 8HCl = 2FeCl_3 + FeCl_2 + 4H_2O$$
$$Fe_2O_3 + 3H_2SO_4 = Fe_2(SO_4)_3 + 3H_2O$$
$$Fe_2O_3 + 6HCl = 2FeCl_3 + 3H_2O$$

The metal is attacked with evolution of hydrogen, and the slightly-attacked scale falls to the bottom of the bath.

The carbide and graphite in cast iron do not take part in the reaction, and this is the reason that overpickled cast iron has a black coating of carbon. Hydrogen brittleness, another result of overpickling, is caused by the hydrogen entering the steel, probably between the crystal boundaries, and can be largely removed by heating in boiling water.

In pickling brass, the action is quite different as the attack on the metal is slower than on steel, and there is no appreciable evolution of hydrogen, the oxide combining directly with the hydrogen. The oxides of brass are mostly cuprous oxide, Cu_2O, which is red; cupric oxide, CuO, which is black; and zinc oxide, ZnO, which is white when pure and alone. The relative amounts of these oxides present in the scale depend upon the composition of the brass, the presence or absence of lubricants on the surface, and upon the heat-treatment. The reactions of these oxides with sulphuric and hydrochloric acids are shown approximately in the following formulas:

$$Cu_2O + H_2SO_4 = CuSo_4 + Cu + H_2O$$
$$CuO + H_2SO_4 = CuSo_4 + H_2O$$
$$ZnO + H_2SO_4 = ZnSo_4 + H_2O$$
$$Zn + H_2SO_4 = ZnSo_4 + H_2\uparrow$$
$$Cu_2O + 2HCl = 2CuCl + H_2O$$
$$CuO + 2HCl = CuCl_2 + H_2O$$
$$ZnO + 2HCl = ZnCl_2 + H_2O$$
$$Zn + 2HCl = ZnCl_2 + H_2\uparrow$$

None of the pickling acids, H_2SO_4, HCl, and HNO_3 have any effect on sand, and hydrofluoric acid has little effect on steel but reacts rapidly with sand, and so is the only bath available for this purpose. The reaction is as follows:

$$2H_2F_2 + SiO_2 = SiF_4\uparrow + 2H_2O$$

As the pickling process goes on, the constant evolution of hydrogen gives a decreasing concentration of ions with a decreasing rate of pickling. The addition of more acid will not help in proportion to the amount of acid added, because the per cent ionization is lowered by the presence of the ferrous sulphate, or other product.

Efficient production requires a high temperature of operation to give maximum activity to the acid ions. The use of a good inhibitor localizes the acid attack, to a large extent, to the scale, and greatly reduces the evolution of hydrogen and acid fumes. The steam and fumes that are still given off should be taken care of by an adequate ventilation system before they have had an opportunity to get out into the room. Other points that need attention and modernization in many plants are provision for keeping the floors dry, elimination of leaky tanks, and suitable work-handling racks, hoists and other equipment. One plant manager found, on investigation, that one of his tanks was using twice as much acid as another near by, because the one tank was tight and the other had leaky joints.

· BOOK · REVIEWS ·

STRENGTH OF MATERIALS. By Alfred P. Poorman, professor of applied mechanics, Purdue University. Three-hundred forty-three 6x9-in. pages. Published by McGraw-Hill Book Company, Inc., 370 Seventh Ave., New York, N. Y. Cloth board covers. Price $3.

PRIMARILY a textbook for undergraduate courses in mechanics, Professor Poorman's work is an often used reference book by many engineers. The revised features of this second edition include impact loading of beams, riveted joints, beams and columns of timber, and continuous beams.

A large number of problems with answers are given at the end of each subject, there being several groups of such problems in each chapter. Among the tables in the present edition are those giving safe working stresses for timber, safe stresses in structural steel as recommended by the U. S. Department of Commerce, and by the American Institute of Steel Construction, and properties of American standard beams, channels, and angles. The fundamentals of the book apply to all branches of engineering; the illustrations and tables apply largely to civil engineering.

MATTHEW MURRAY, PIONEER ENGINEER. By E. Kilburn Scott. One hundred thirty-two pages, 5½x8½ in. Published by the Matthew Murray Memorial Fund, Westminster Bank, Leeds, England. Price 2/6d.

ALL who are interested in the origin and development of mechanical devices and methods will be glad to read not only of the achievements of Matthew Murray, to whom we evidently owe more than most of us realized, but of his struggles against powerful odds. Written for the hundreth anniversary of his death, it outlines the active part he played in developing many types of machinery. For seventeen years before Stephenson's "Rocket" won the Rainhill contest, Murray's locomotives are reported to have been running regularly between Hunslet and Middleton, a 5-ton locomotive hauling 90 tons. George Stephenson, it is reported, came to Leeds the next year, 1813, to see Murray's locomotives at work.

Murray seems to have been both fertile in ideas and versatile in his inventions. He was also fortunate in having his ideas credited to others, his patents nullified and his ambitions thwarted. His parallel motion was erroneously credited to James White, some of his patents on steam engines were set aside in favor of Boulton and Watt, who, according to their own letters, were guilty of about all the unethical practices with which business men could be charged. Those who do not appreciate how modern business has advanced ethically, will do well to read the letters of Boulton and Watt as published in this volume. Nothing in this century will equal them for ruthlessness and trickery in dealing with a competitor.

Born in 1765 and passing in 1826, Matthew Murray left us much by which he should be remembered. His work included the spinning of flax, boilers, pumping engines, steam heat in houses, locomotives, boring mills, hydraulic-testing machines, and the like.

MANUFACTURING COSTS AND ACCOUNTS. By A. Hamilton Church. Five-hundred sixteen pages, 6x9 in. Published by McGraw-Hill Book Company, Inc., New York. Cloth board covers. Price $6.

"THE Why of Cost Accounting" might have been used as sub-title for this book, now in a thoroughly revised second edition. It aims to show the cost accountant the relation of his work to the general account of the firm, and to present a rather simple view of the general structure of cost accounts, thus providing the reader with fundamental information that will prepare him for understanding cost accounts and the necessary reports and returns, or for dealing with cost accounting problems.

In this edition, each section of each chapter has been provided with a sub-title in bold type as an aid in reading and reference. The three parts of the book cover: General Outline of Manufacturing Costs, Cost Accounting, and Factory Reports and Returns. Several charts are used to illustrate the text, and thought provoking questionnaires are given at the end of each chapter.

STANDARDS YEARBOOK, 1929. Miscellaneous Publication No. 91. Compiled by the National Bureau of Standards, Department of Commerce. Four-hundred one 9x6-in. pages. Indexed. Sold by the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. Price $1.

WHEREAS special attention was paid in previous issues of this yearbook to the organization and procedure of numerous standardizing agencies in this country and abroad, this third volume lays special emphasis on the accomplishments for 1928, and on the future programs of various technical societies and trade associations. As in previous volumes, it also contains outlines of the activities and accomplishments of the National Bureau of Standards and other agencies of the Federal Government, and of the States, counties and municipalities as well. Other special features are: Standardization of weights and measures, simplification of the calendar, and a bibliography on standardization.

WERKSTOFF-HANDBUCH STAHL UND EISEN. Edited by Dr. Karl Daeves from the published material of the German Iron Association. About three hundred loose-leaf pages, 7x9 in. Imitation leather covers. Published by the Verlag Stahleisen, Breite Strasse 27, Dusseldorf, Germany. Price 18 gold marks.

AS A materials book on steel and iron for the laboratory man or for the designer who is looking for basic data, this book goes deeply into the technical aspects and apparatus for testing. It is profusely illustrated with charts, testing layout, and micro-photographs. Many tables showing heat-treatments, electrical, and other characteristics, are also given.

Each subject is taken up separately on a sheet or group of sheets, and the material in each case is from a study by a German authority. In some cases a class of steel is treated as a general subject, while in other cases certain phases of a material only are considered. Typical subjects covered on the sheets are: Magnetic properties, non-magnetic steels, boiler steels, steels for deep drawing, vanadium steels, chromium steels, pouring temperatures, hardness, razor steels, pen steels, the hot working of steels.

IDEAS · FROM · PRACTICAL · MEN

The department, "Ideas from Practical Men," is devoted to the exchange of information on methods useful to the machinery industries. Its scope includes all divisions of the metal-working industry, from drafting room to shipping platform. Descriptions of methods or devices that have proved their value are carefully considered, and those published are paid for. The rates are from a minimum of five dollars upwards, depending upon their merit.

Automatic Trip Finger for Progressive Dies

C. M. GRIFFIN

The trip fingers illustrated in Figs. 1 and 2 are intended to demonstrate a principle, rather than serve as a definite method, as each shape of punching requires a different shape or application of trip finger. Every die that uses strip or roll material should be equipped with one, but its success depends upon so insignificant a feature that many toolmakers miss it. The result is, we are told that a trip finger will not work, and that a stop pin is just as fast.

A trip finger, properly made, is from two to four times as fast as a stop pin. It allows the press to be run continously, which means from 120 to 400 pieces per minute. It is less tiring, as the operator trips the press only once for each strip, instead of for each piece.

The automatic stop, or trip pin, shown at Fig. 1 is simple and reliable notwithstanding its looks, for its successful operation depends upon its "sloppiness." This trip works equally well on either thin or thick metal due to the lightness of its parts.

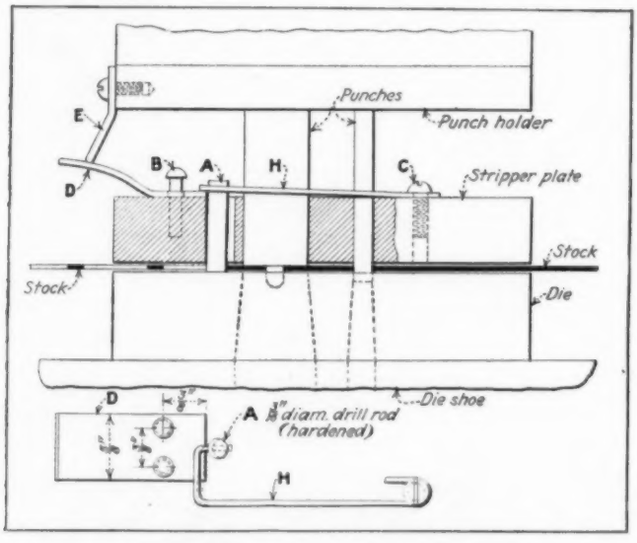


Fig. 1—Automatic trip pin with independent movement that allows the press to work continuously

The illustration shows a progressive die for a single washer. To install the trip a $\frac{7}{32}$ in. hole is drilled in the stripper for the $\frac{3}{16}$ in. stop pin *A*, two holes, a drive fit for a $\frac{1}{8}$ in. rivet *B*, and one hole tapped for a 12-24 screw to hold the spring *C*. The lever *D* is of $\frac{1}{16} \times \frac{5}{8}$ in. steel bent as shown, and with two $\frac{7}{32}$ in. holes, spaced the same as the rivet holes in the stripper. The function of this lever is to rock, and lift the stop pin *A* each time the ram descends. The finger *E*, attached to the punch holder, actuates it.

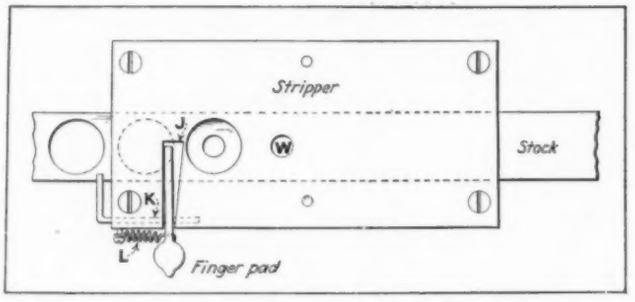


Fig. 2—A lever adaptation of the principle. The spring holds the finger tip down, and toward the punch

It will be noticed that two loose fits are provided, one around the two rivets, which allows the lever *D* to move freely, and the $\frac{7}{32}$ in. hole in which the $\frac{3}{16}$ in. trip pin works. Its successful operation depends upon this loose fit, and upon bending the spring wire *H* so that the trip pin *A* will crowd against the side of the hole next to the punch. If it is not so adjusted, or if the fit is not very loose, it will not work.

In operation, the material to be punched is fed against the trip pin, pushing it hard against the front side of the $\frac{7}{32}$ in. hole. It is obvious that the pin must not move until the punch has cut through the material, and will therefore be released before it leaves it. Under these conditions, unless there is an independent movement of the trip pin after it is lifted, it will simply fall back into the same place, and the stock cannot be fed forward. But with room to move, and with a tension pulling it in the opposite direction from that in which it is forced by the stock, the pin comes down on the top of the strip, and as the stock moves forward it slides into the next hole and repeats the cycle.

Fig. 2 shows an adaptation of the same principle, used by some firms. In this case the independent movement of the trip finger is secured by the loose fit at *J*. To function properly it is evident that the hinge *K* must also be loose, and the spring must pull in the proper direction.

Tapping Soft Materials

BY MALCOLM K. PARKHURST

Experimental model-work frequently calls for tapped holes in such materials as hard rubber, fiber, wood and the like. In connection with such work, I make use of what may be called a "lead" plate. By its use, remarkably clean and accurate threads can be cut with an ordinary tap, even in such a material as pine wood.

The "lead" plate is nothing more than a small piece of metal, brass, steel or iron in which a hole of the de-

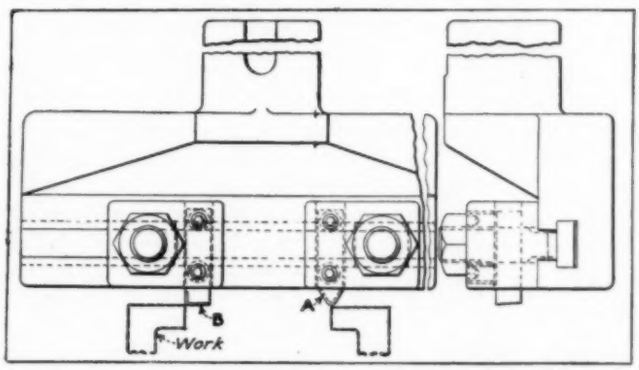
sired size has been tapped. It should be of sufficient thickness to accommodate about three or four threads. In operation, the "lead" plate is floated over the hole to be tapped and is held lightly in place with the fingers while the tap is revolved through it into the soft material below. Inasmuch as the feed is thus automatically assured, the threads will come out clean and true. Where one has occasion to thread very small holes, the tap can be dispensed with and the screw itself can be made to cut its own thread by screwing it through the "lead" plate in the same manner as is done with the tap.

Adjustable Rough and Finish Facing Tool

By J. E. Fenno

The tool shown in the illustration was designed for rough and finish facing in a turret lathe in which the turret is mounted on a cross-slide. As will be seen, the roughing cutter *A* and the finishing cutter *B* are adjustable in the holder to suit the diameter of the work to be faced.

The blocks in which the cutters are held are attached to the holder by bolts, the holder being slotted to allow



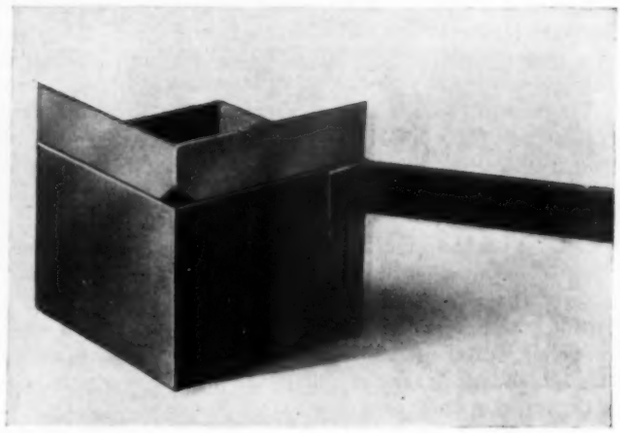
Rough and finish facing tool for the turret lathe

them to be positioned in any part of the holder. The blocks are reversible so that they may be set to bring the cutters as near the ends as possible. The block holding the finishing cutter is somewhat higher than the one holding the roughing cutter, due to the fact that the finishing cutter is inverted.

Babbitt Ladle With an Adjustable Opening

By A. Kendall
Hamilton, Ont., Canada

It is difficult to control the flow of babbitt metal from an ordinary ladle, and consequently there is a great deal of splash and waste when a small flow only is required. A square ladle offers three convenient pouring mouths, and it can also be fitted with a simple attachment for controlling the flow. As shown in the illustration, the attachment consists of a piece of sheet metal bent in the center at a right angle, and cut to fit snugly between the opposite corners of the ladle. It is higher than the depth of the ladle and has a diamond-shaped hole cut in the bend, slightly above the center. In operation, the attachment is pushed to the bottom of the ladle, and the diamond-shaped hole, in conjunction with the corner of



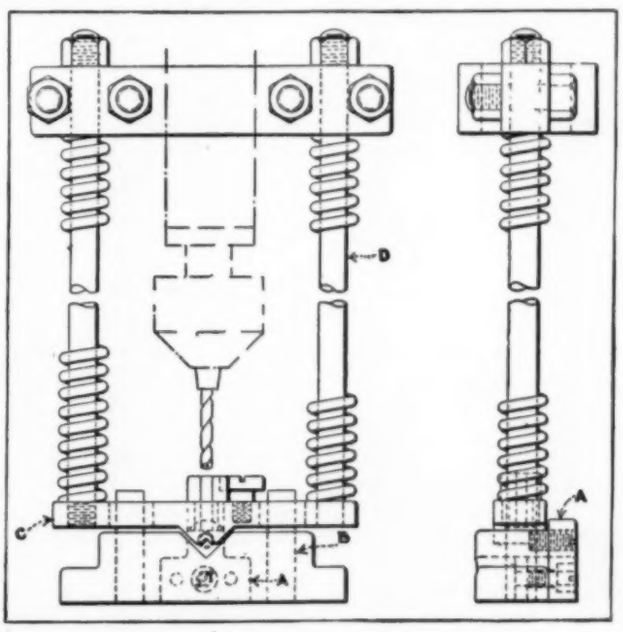
Ladle with an adjustable opening

the ladle, forms an opening of definite size. If the diamond-shaped hole is cut so as to be just below the top of the ladle when the lower edge of the attachment is at the bottom, the size of the opening can be varied by raising the attachment more or less. If the attachment is made to fit snugly between the corners of the ladle, it will not tip while the metal is being poured.

Jig for Drilling Holes in Rods

By C. M. Otis
Tool Engineer, American Laundry Machinery Company

In the sketch is shown a convenient jig for drilling small holes near the ends of rods for cotter pins. The lower piece, or work holder, is a V-block having projections on the ends for clamping it to the drill-press table, and having a plate *A* at the rear in which a set-screw is located in line with the V, and which acts as an adjustable stop for the rod to be drilled. Two guide pins *B* are pressed into the V-block to guide the pressure plate *C*, which is arranged for carrying a series of removable drill bushings for different sizes of drills. The pressure plate is free to slide up and down on the guide



Jig for drilling cotter-pin holes in rods

pins and is held against the work by two long springs on the rods *D*, the lower ends of which screw into the pressure plate, while the upper ends pass through holes in a clamp.

The clamp is made in two parts to fit the quill of the drill press. The upper ends of the rods are threaded, so that any desired tension can be put upon the springs by screwing down the nuts. The length of the rods must be determined by the length of the drill and that of the chuck. The clamp is adjusted so that when the operating lever moving the spindle is up, the pressure plate is clear of the work, and when it is down and the drill is cutting, there is sufficient pressure on the work to hold it. While the spindle is moving down and the drill is cutting through the work, the clamp slides on the two side rods against the spring pressure.

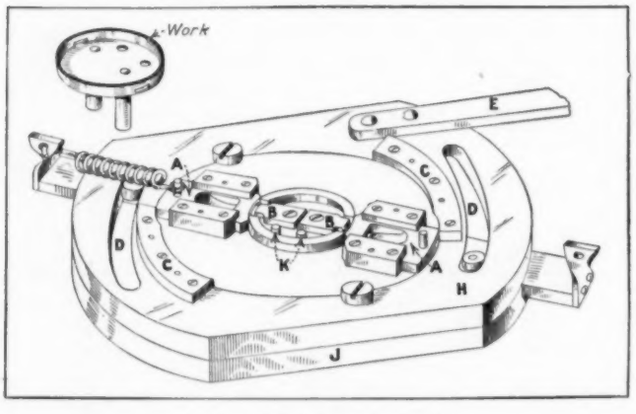
The jig will be found to be rapid in operation, and with different sizes of drill bushings it will take care of a number of different sizes of holes and diameters of rods.

Press Tools for Slotting Ammeter Bases

By Charles H. Willey
Asst. Plant Supt., Hoyt Electrical Works

The illustration shows a set of press tools by which we were able to slot ammeter bases so that the upper edges of the slots were flush with the under sides of the tops of the bases. It was impossible to put the punches on the outside, since if the dies were on the inside, the slots could not be punched in the desired location. We desired to punch both slots at the same time, so, after some experimenting, we designed and made the tools shown in the illustration.

The dies *A* and the punches *B* both travel. The dies are forced inwardly by the cam plates *C* and the slides carrying the punches are forced outwardly by the cam



Tools for slotting ammeter bases

slots *D* acting on rolls on the slides. A stiff coil spring attached to the dies withdraws them after the piercing operation. The punchings are cleared through channels in the dies.

In operation, the whole tool-set is mounted vertically on an angle plate on one side of the press, circular movement being imparted to it through the arm *E*, which is connected to the ram of the press. By this means, the plate *H* is rotated on the bed *J*, moving the dies inwardly and the punches outwardly by the cams. The bases are located by the pins *K*. The production is from 1,000 to 1,400 per hour.

A Non-Shrinking Iron Filler

By E. Perry

Regardless of the efforts of the foundry to produce perfect castings, a percentage of them will have surface defects. Fortunately it is possible to treat blemished castings, from the standpoint of appearance, so that for all purposes they are practically the same as perfect ones. This is accomplished with an iron cement, kept in powder form and mixed with water to the consistency of putty when required for use.

This putty can be used for filling blow-holes or facing spongy places. It hardens in a few hours, and as it contains a large proportion of metallic iron the patch when dry will closely resemble the original casting. The formula follows:

Iron filings	64 lb.
Plaster of paris	10 lb.
Common whiting	4 lb.
Gum arabic	4 lb.
Bone black	1½ lb.
Portland cement	4 lb.

The ingredients are combined in the order given, preferably by a mechanical mixer, and the resultant powder should be kept in a damp-proof container. The iron filings should be as fine as possible, and never coarser than will go through a 20-mesh sieve. Where very quick hardening is desired, plaster of paris may be substituted for the whiting.

When using, mix only enough for immediate application, into the consistency of a stiff putty. It does not take water readily, so that considerable working is necessary. Apply by whatever means the job demands, such as a putty knife. In cases of cracks and deep holes it should be tapped in with a hammer and then smoothed over. Deep holes should be filled in ¼-in. layers, each being allowed to dry before another is added. Surfacing should not be done until all holes are filled and dry.

This filler has the properties of close and firm adhesion without subsequent shrinkage, and if well done it will never loosen or break out. By test a cubic inch of dried filler had a compressive strength of 6,000 pounds.

Gear Cutting on a Shaper
Discussion

By Matthew Harris

In an article under the title given above, on page 31, Vol. 70, of the *American Machinist*, Wilfred E. Johnson tells how to cut gears on a shaper. While the method he describes might do for a rough job, or for gears that run very slowly, accuracy is out of the question. Makers of gear cutting machines have spent time and money in perfecting the index wheels of their machines so that they would divide the tooth spaces accurately, and to come back to dividing them by hermaphrodite calipers is a long step backward.

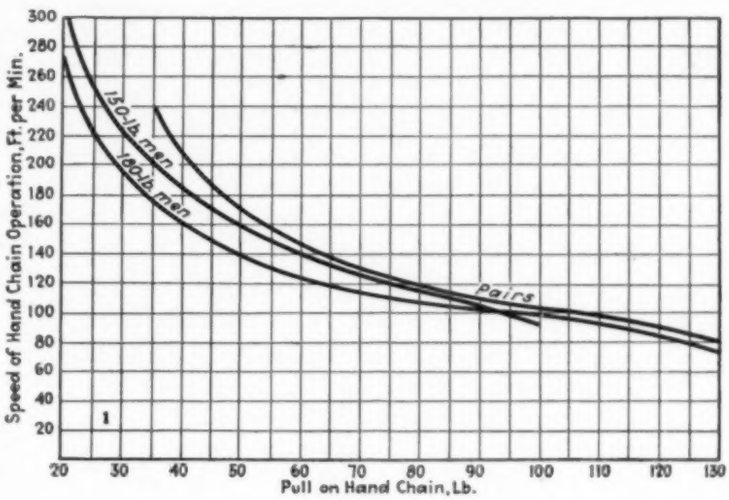
The worst planer I ever bought, though made by a reputable machine tool builder, had a bull gear that was cut to scribed lines. The lines were scribed, not by hermaphrodite calipers, but in a gear cutter that was not heavy enough to do the cutting, using a stationary straight-edge to guide the scriber after each indexing. Needless to say, that planer did not stay in my shop very long.

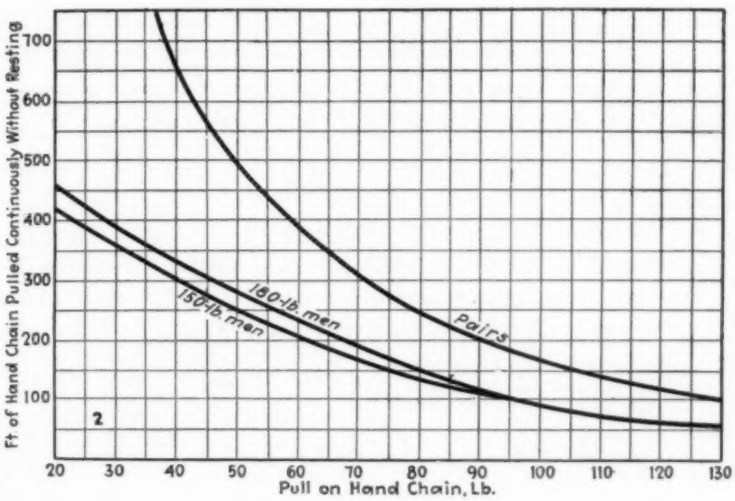
Speed of Hoisting with Chain Hoists

Tests involving eleven operators, 23,550 ft. of hand chain operation, 153 min. pulling time, and 1,268,000 ft.-lb. of work, form the basis of the data given by the accompanying curves. The hoist used had a 30-ft. lift and was equipped with 50 ft. of hand chain, one link being marked so that stop watch readings could be taken for each cycle of 50 feet.

The operators were divided into three squads according to weight, three large men averaging 180 lb. forming the first squad, six medium men averaging 150 lb. forming the second squad, and eight men working in pairs forming the third squad. The men were instructed to avoid competition and to perform the work as if it were their regular job, it being immaterial whether they lifted quickly or slowly, in one continuous operation, or by a series of lifts with resting periods in between.

From Fig. 1, it is evident that 180-lb. men can exert pulls up to 130 lb., but that their

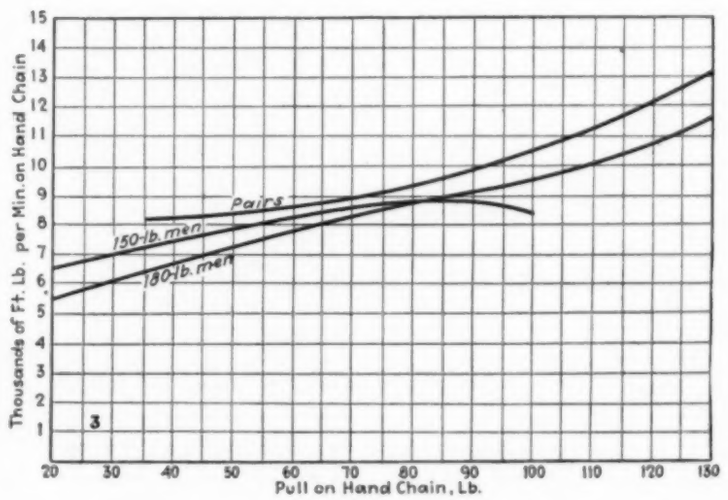




speeds are slower for pulls below 90 lb. than 150-lb. men. The endurance of large men, from Fig. 2, is evidently only slightly greater that that of medium weight men. As the pulls decrease, the pairs show greater endurance, probably due to each man waiting for the other to give the signal to stop. In Fig. 3 it is shown that the large men produced less energy for light loads than do men of medium weight.

Catalog values of the force required to operate various sizes of chain hoists at capacity load were obtained by tests in which weights were attached to the hand chain until the load was moved.

As an example of the use of the data, assume that a 5,000-lb. load is to be lifted with a 6,000-lb. capacity hoist, and that the catalog value for the force required to lift the 6,000 lb. is 127 lb. Then, the force to lift 5,000 lb. is $5{,}000 \div 6{,}000 \times 127 = 106$ lb. Referring to Fig. 1, it will be seen that a large man can attain a speed of 95 ft., or a pair of men 100 ft., of hand chain per minute with this force. If the catalog value for velocity ratio, or the feet of chain handled to lift the load one foot, is 59 to 1, then the load will be raised $95 \div 59 = 1.6$ ft. per minute by the large man, or $100 \div 59 = 1.7$ ft. per minute by the pair. Reference to Fig. 2 will indicate, from the distance the load is to be lifted, whether the operator can lift the load the entire distance without rest periods, and if not, about how many rest periods will be required. Assuming that the load is to be lifted 6 ft., the necessary hand chain movement is 6 ft. times the velocity ratio 59, or 344 ft. Fig. 2 shows that the single operator can overhaul about 80 ft. and a pair about 150 ft. of hand chain, without fatigue. Therefore, $\frac{344}{80}$ or about 5 working periods are required by an operator.



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American Machinist

Editors: KENNETH H. CONDIT AND FRED H. COLVIN

Established 1877

Industrialism in the South

LAST year the *American Machinist* published on page 607, Vol. 68, an article on the machinery development in the New South. For some time there has been an appreciation in the North of a growth of industry in the south-eastern states, but just how much that development has been, and how much it will affect the country as a whole, has seemed to be somewhat indefinite.

With something of the same thing in mind, but with all American business as the viewpoint, an industrial survey has just been made by a group of editors of the McGraw-Hill Publishing Company, publishers of the *American Machinist* and twenty-four other technical, trade, and business journals. The editorial party visited twenty-two industrial centers in seven states, inspecting eighty industrial plants, and were received by the leading industrialists and business men of the region.

Out of the mass of impressions gained, some very definite factors in the rise of the new industrial South were apparent. Industries have already begun to center themselves in groups just as they have always done in new countries, but not for the old reasons of centralized capital or immobility of skilled labor. In the South great industries are building up around the sources of raw materials and at almost ideally located shipping centers, giving pronounced advantages over many older plants in other sections of the country. Starting from "scratch," and with the knowledge of experience and mistakes made in the past in the North, most of these plants are being completely equipped with the most modern machinery. Moreover, they are drawing on a hitherto untapped source of labor, obtaining from the hill counties a great store of intelligent labor of sturdy Anglo-Saxon and Scotch-Irish stocks.

New England has felt the influence of the South in the loss of many of its cotton mills, but in general the development has been along the lines of new growth based on raw materials and new requirements. Many branch plants are also being established in these Southern cities, and numerous machine shops have followed the rise of the mills, and chemical and steel plants. With the many things that the south-eastern states have to offer, together with the peculiar advantages of a fresh start at a period in history when there is recognition of the value of improved machinery and when the relations between labor and management were never better, the new industrial South should show in the next few years a remarkable growth that will benefit the whole country.

What this all means to the metal-working industry is apparent. The development of the iron and coal at Birmingham has resulted in the growth of large shops in that center building sugar-mill machines, chemical apparatus, and cotton mill machinery. Following the great hydro-electric developments there have been established very large repair shops which in some cases have actually begun to manufacture air compressors, oil engines, and other equipment regularly. Machine-tool building has not begun, but there are numerous plants of considerable capacity turning out gears and other machine parts on a production basis.

Scrapping Spoiled Work to Cut Waste

WASTE prevention in the manufacturing plant usually includes the repair or salvaging of defective parts or products wherever possible, as well as direct efforts to reduce spoilage in processing. But does the fact that damage can be rectified react against careful workmanship, and actually raise the rate of spoilage? One well-known organization believes that such is the case, and scraps defective parts without any attempt to repair them.

The objective is psychological, and the plan produces excellent results. Of course, the parts are not just thrown away. They are exhibited to the group or individuals responsible, to have the errors avoided in future production. Then, regretfully, they are reduced to scrap. The impression created is two fold. First, the company will turn out only perfect products, and the workmanship must reflect this quality. Second, a lot of money is wasted by junking all materials and labor put into the product up to the time of spoilage. No redeeming feature, no minimizing of the loss, enters into the situation, through the idea that the damage will be partially offset by repairs.

This company, whose material and labor costs are relatively high, has reduced its spoilage to a remarkably low figure by the simple plan of dramatically scrapping all spoiled work. This plan will produce equally good results in almost any factory if suitably applied under local conditions.

General Electric Hydrogenated Copper Brazing Furnace

ECONOMICAL copper brazing of fabricated iron and steel products on a mass-production basis is possible by means of a hydrogenated furnace placed on the market recently by the General Electric Company, Schenectady, N. Y. Conveyors are used to carry the work to and away from the furnace, as well as transport it to the heating and cooling zones of the interior. The only labor involved in its operation is that necessary to keep the furnace supplied with work, since the furnace itself is automatic in operation.

As was brought out in an article entitled, "Copper Brazing in a Hydrogenated Furnace," on page 803, Vol. 68, of the *American Machinist*, the presence of hydrogen in the furnace cleans the metals to be brazed and not only obviates the necessity of any flux but also insures the flowing of the copper used in brazing into the joint to be united. In addition, the capillary attraction draws the fluid copper into the smallest crevices of the joints. In preparing the work for brazing, the parts are either wound with copper wire or painted.

In Fig. 1 is shown a tunnel-type furnace used for this process. The furnace proper rests on supports above a roller conveyor, on which are a row of trays carrying the work to be loaded. Openings are provided at either end and in the bottom of the furnace. The furnace is heated at the entrance and cooled at the other end. Motor-operated elevators, located beneath the furnace openings, raise the trays of work into or lower them from the furnace. In Fig. 2 an example of how the work is charged into the furnace is shown.

In operation, the trays are loaded on the roller conveyor, which is completely covered with them from end to end, the work being evaporators for refrigerators in this case. At the beginning of the cycle, the elevators are in the lower position. A motor-operated ram at the right pushes the tray from the discharge elevator onto the conveyor. The elevators then ascend automatically until the work enters the heater end of the furnace, while the empty elevator is ready to receive a tray of brazed work at the discharge end. Another motor-operated ram pushes the intake tray into the furnace and thus pushes out a tray of completed work upon the elevator at the other end. The furnace is equipped inside with a conveyor system similar to the one below it. The elevators now drop to a lower position once more and the cycle is repeated.

In loading the work on the trays, it is arranged on vertical supports as shown in Fig. 2. When in the heated end of the furnace, the tray itself is carried in a lower chamber, the vertical supports projecting up through a slot and thus keeping the work in the heated portion of the furnace, while the tray is protected. As a further protection to the tray, it is covered with heat-insulating material.

The furnace is heated to about 1,100 deg. C., or 2,012 deg. F. Since hydrogen is lighter than air, it remains in the furnace while the charging doors are open. The two furnace openings are closed by a horizontal door, which, when the elevators are in the upper position, is also raised out of the way. When the elevators drop, the door drops also, settling into a sand seal, thus minimizing losses of heat and gas.

The heating units located at the entrance end of the furnace are arranged in several zones, the tem-

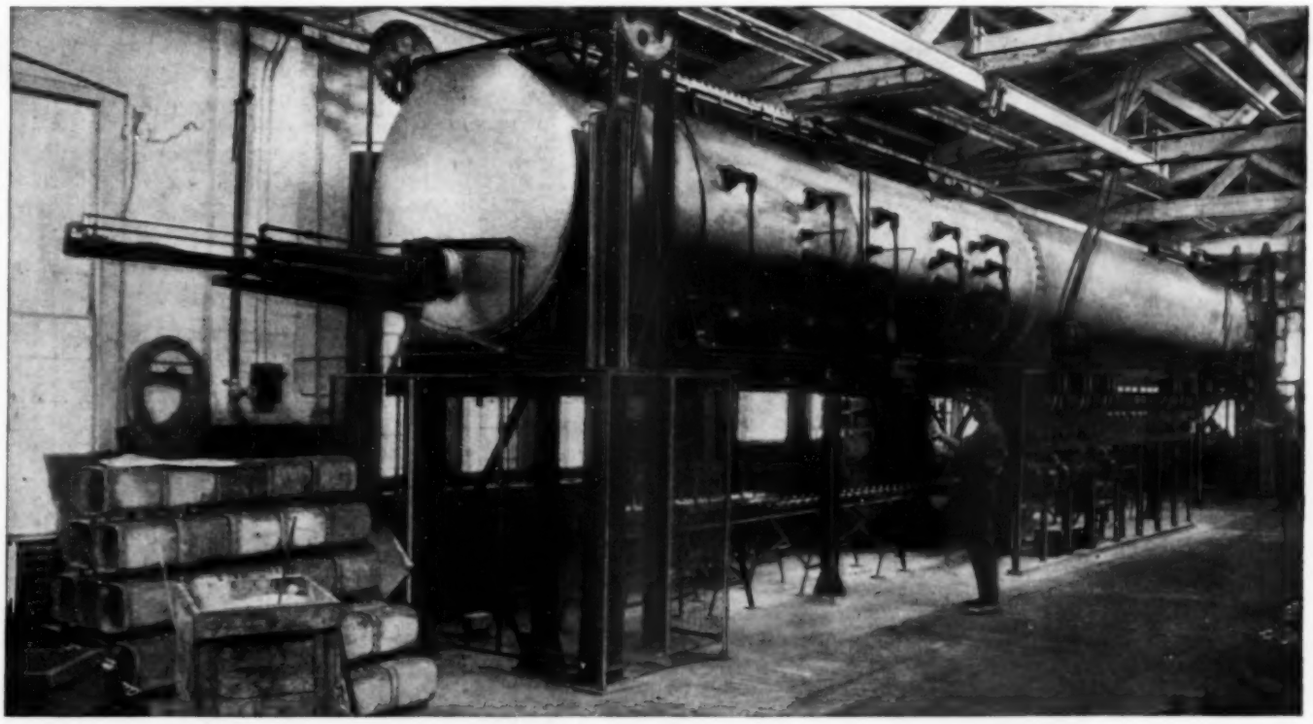


Fig. 1—General Electric Hydrogenated Furnace arranged for copper brazing evaporators for refrigerators

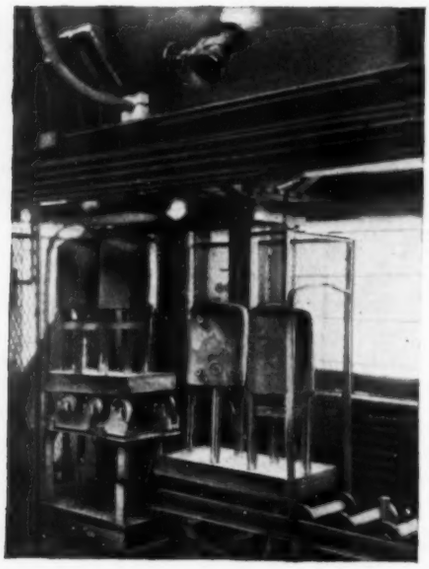


Fig. 2—View showing the charging of evaporators into the heating end of the furnace

peratures of which are controlled automatically. There is a short neck just beyond the heating zone where some cooling takes place, while the remainder of the furnace is water-jacketed for final cooling. This water-jacketing is so effective that the work, when it leaves, has a temperature below that at which oxidation will take place.

The time for the complete cycle of operation is adjustable between certain limits. There is also a time interval between the completion of one motion and the beginning of a succeeding motion, and this is adjustable from ½ to 1½ sec. The time between cycles is adjustable by means of a master timing relay which has a range from 5 sec. to 33 min. This range of adjustment allows a wide range of products to be brazed.

The control panels are equipped with reversing and accelerating contactors, field acceleration relays, thermal overload relays, line and control knife switches for small motors, a master timing relay, and single-pole, double-throw control transfer switch, and interlocking relays.

Wagner Small Standard Vertical Motors

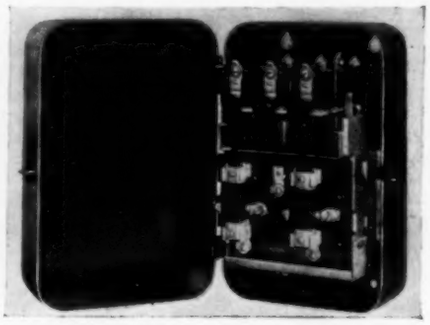
Interchangeability of various sizes on the same mounting base, because they all have the same flange or lug dimensions, is an important feature of the line of small standard vertical motors announced by the Wagner Electric Corporation, 6400 Plymouth Ave., St. Louis, Mo. This feature makes it unnecessary to change the mounting base in order to interchange vertical motors of different types and ratings. The line includes repulsion-induction, split-phase, squirrel-cage and d.c. motors, built in 25- to 60-cycle models, for operation at 1,200 to 3,600 r.p.m. The ratings range from ⅛ to 1½ hp. Either oblique, vertical, or horizontal mounting can be used, at the option of the purchaser. Another feature is the Wagner "labyrinth" seal which prevents leakage of lubricant into the motor windings and effects a dustproof, leakproof, bearing housing.

Wagner Small Standard Vertical Motor

Condit Type A-30 Across-the-Line Starter

Intended for use with squirrel-cage induction motors, the Type A-30 across-the-line motor starter has been announced by the Condit Electrical Manufacturing Corporation, 838 Summer St., South Boston, Mass. The starter is built in sizes for motors up to 20 hp., operating on 550 and 450 volts, 15 hp. for 220-volt circuits, and 7½ hp. for 110-volt circuits.

According to the manufacturer, arc prevention is brought about by practically minimizing ionization. No use is made of circuit-interrupting devices intended for the extinguishing of the arc after it is formed. Tests have shown that a spark occurs only when current six to seven times the normal rating of the device is passed, and that there is relatively no contact burning and no gas is evolved, thus permitting a minimum of maintenance. Having no barriers or arc chutes, the type A-30 is simple and compact in design, and is enclosed in a substantial pressed-steel case arranged for conduit knockouts. It may be furnished with thermal relays for time-lag overload protection and with undervoltage protection.



Condit Type A-30 Across-the-Line Starter

Oliver No. 191 Tilting Arbor, Motor-Driven Saw Bench

Like the larger model announced on page 238, Vol. 68, of the *American Machinist*, the worktable of this No. 191 motor-driven circular saw bench remains stationary while the arbor is tilted to any angle up to 45 deg. to enable the operator to either rip, cross-cut, miter, or dado, while the work remains flat on the horizon-

Oliver No. 191 Tilting Arbor, Motor-Driven Saw Bench

tal table. The unit has been added to the line manufactured by the Oliver Machinery Company, Grand Rapids, Mich., for pattern shops and shipping rooms. The machine is portable and operates from an electric light socket. It will cut 2 in. deep, with a standard 7-in. saw, or 2½ in. deep with an 8-in. saw. It will dado up to ⅞ in. wide by 1½ in. deep. It will also groove the same width and depth for ripping, cutting tongues and grooves, and will cut compound miters in one operation, and tenons.

A graduated scale at the front of the machine shows the angle of inclination to which the saw is tilted for angular sawing. The saw may be raised and lowered for changing the depth of cut. This allows the table to be located at the actual working height at all times, and not be raised too high for dado work and too low for other operations. The machine is ball-bearing equipped throughout. The table has an area of 25x30 in. and the machine is driven by a standard ½-hp. motor.

Gleason 60-Inch "Hypoid" Gear Generator

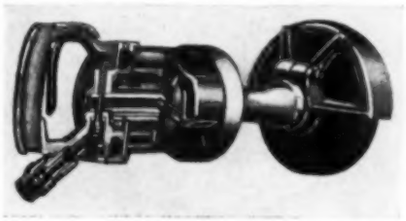
EQUIPMENT for cutting large "Hypoid" gears is a recent development of the Gleason Works, Rochester, N. Y. This equipment consists of a large gear generating machine designed for cutting spiral bevel gears with the addition of a special workhead for cutting "Hypoid" pinions. In addition to the usual adjustments of the spiral bevel gear head, the Hypoid head gives two others. First, the work spindle can be offset vertically above or below center, so that the pinion can be cut in the same relative position in the machine as the position in which it is to run with the mating gear. Second, a small transverse adjustment of the head is supplied. The slides for these adjustments can be observed in Fig. 1. An article entitled "The Design and Manufacture of Hypoid Gears" by Arthur M. Stewart and Ernest Wildhaber appeared on page 857, Vol. 64 of the *American Machinist*.

The Hypoid head can be used for cutting Hypoid pinions and spiral bevel pinions and gears of small pitch diameter. The approximate maximum dimensions of gears that can be cut with this equipment are 60 in. pitch diam., 30 in. cone distance, 8 in. face width, 1½ D.P., from 0 to 25 deg. spiral angle with ratios between 1 to 1 and 1 to 10, and 10 in. vertical offset.

According to the manufacturer, there are two important advantages of Hypoid gears; first, the small amount of lengthwise sliding of the teeth introduced by the offset serves to make them run smoother than spiral bevels, and, second, the offset between the axes makes it possible for both the gear and pinion shafts to continue past each other.

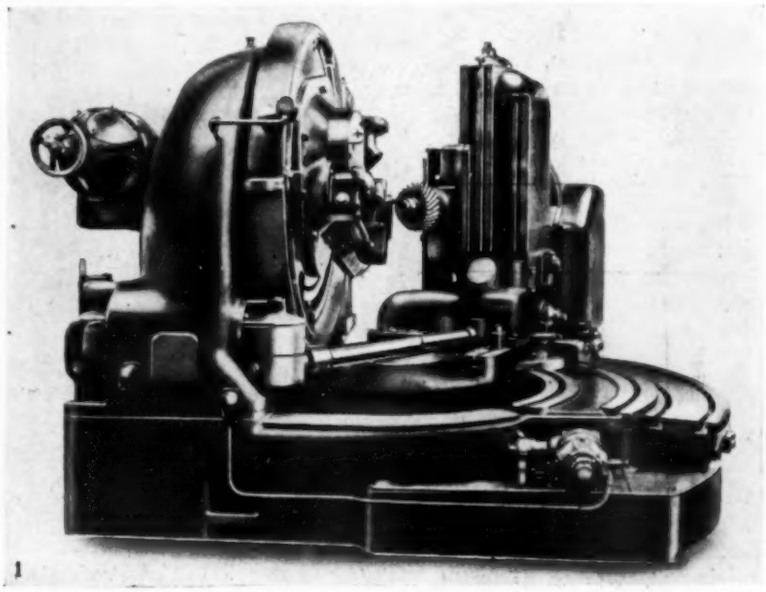
"Hercules" Portable Air Tools

A line of "Hercules" portable air tools that comprises grinders, buffers and drills has been announced by the Buckeye Portable Tool Company, Dayton, Ohio. The principal characteristic of the line, according to the manufacturer, is freedom from vibration brought about by balancing



Cut-away view of a "Hercules" portable air tool arranged as a grinder

the parts. Smooth, even speed is obtained through the patented airport construction, which gives several constant streams of air to the motor. Low air consumption is due to the



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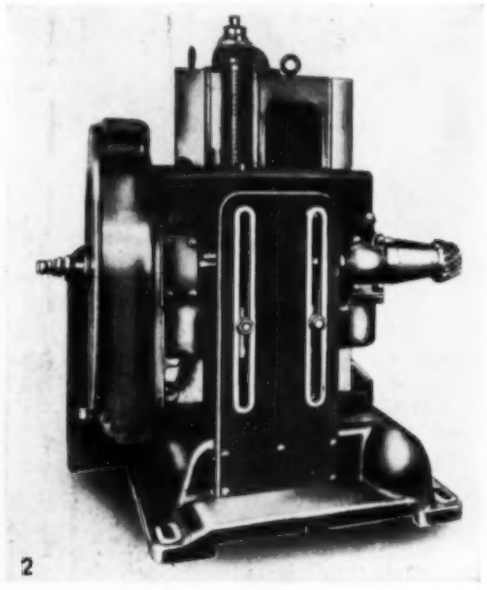

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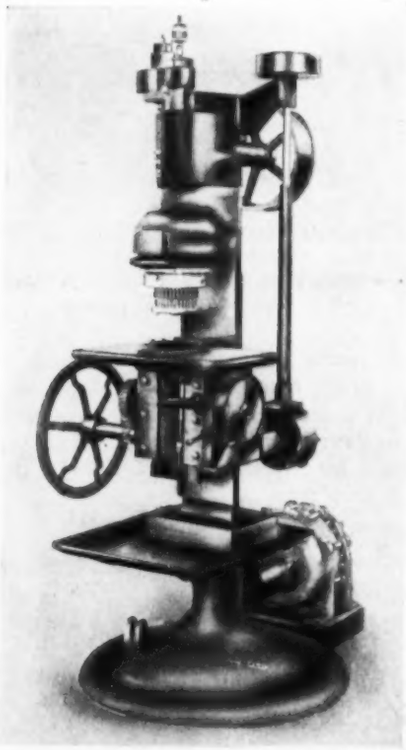
Fig 1—Gleason 60-Inch "Hypoid" Gear Generator. Fig. 2—Showing method of obtaining offset for the pinion when cutting

same feature. Any tool can be handled with ease, it is claimed, because of its minimum weight and correct balance.

Interchangeability of parts, especially handles, permits machines of the same capacity to be changed from a grinder, as illustrated, to a buffer or drill for use in various positions. It is said that the entire tool can be disassembled and reassembled in from 15 to 20 min. Automatic, foolproof lubrication is brought about by the use of the Alemite system.

Langelier Multiple Drilling Machine with Power Feed

POWER feed is featured on the multiple drilling unit made by the Langelier Manufacturing Company, Arlington, Cranston, R. I. The particular machine shown in the illustration was used for drilling 96 No. 33 (0.113 in.) holes, spaced on ⅜-in. centers, in a circular gas burner in one operation, but almost any combination of spindles can be obtained. Three to four burners can be drilled per minute.



Langelier Multiple Drilling Machine with Power Feed

The table has a working surface of 20x12½ in., and the maximum distance from the drill chuck to the table in its lowest position is 14 in. The entire table unit is adjustable on the column up to the point of contact with the drillhead. Power feed travel vertically of 7 in. is provided and the distance from the center of the drill head to the column is also 7 inches.

Drive for the machine is obtained from a motor mounted on the rear of the base to a pulley at the upper part of the machine at the rear, but if required, the machine can be arranged with a tight and loose pulley drive from a countershaft. From the main drive the table feed is actuated by a pinion and gear unit belted to a vertical, telescoping shaft, which drives in turn through bevel gears to a drop-worm and wormwheel. The wormwheel shaft carries a pinion meshing with a rack for obtaining the table travel. The table carries an adjustable knockout lever for throwing out the drop-worm at the desired point in the feed. Hand feed is also provided through a handwheel at the left of the table.

The drillhead itself is of standard design, and the number and spacing of the spindles can be arranged to suit. The multiple-spindle head and housing are bolted to the front of the column in a fixed position, since the table is moved in order to obtain the feed. The head and housing are made with cast-in water jackets as it is necessary to carry away the heat generated as fast as possible. This heat is caused by the rapid movement of a large number of parts confined in a small space. The water jackets are connected by flexible hose to an overhead tank of ample capacity, and, by convection, circulation of the cooling water takes place.

Crank Drive Used

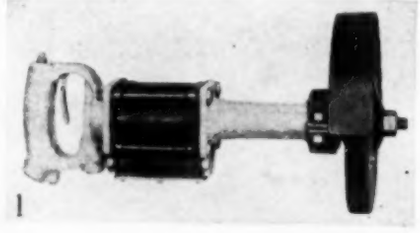
Because of the small space also crank drive through an eccentric spindle driver is used to rotate the drills Each spindle with its crank at the upper end is forged from the solid, and is pack hardened and ground, leaving a soft core. The spindle driver consists of a disk in which the crank ends are fitted, thrust being taken by a single ball at the end of each spindle crank. This spindle driver in turn is carried in an eccentric head forged integral with the spindle, which is 0.40 carbon steel, hardened and ground. Two ball thrust bearings and a radial deep-groove ball bearing carry the loads on this spindle. The water-cooled head proper is made of bronze, which forms a natural bearing material for the spindles, which are carried through it. Bevel gears also pack hardened are used for driving the main spindle.

The photograph shows only one pair of feed driving pulleys. This was special for drilling the burners, but the machine is generally arranged with a pair of three-step cone pulleys to give three changes of feed.

The lubrication of the 96 multiple drill spindles in the drillhead is obtained by a large stationary sight-feed oiler mounted at the top end of the main driving spindle. Lubricant flows from this point through a tube projecting into a hole drilled the entire length of the main spindle and leading into the driver to each of the spindles.

"Rotor" No. D-3 High-Production Grinder

Designed for use with 8x1-in. rubber, Bakelite, and elastic-bonded wheels at high speed, a high-production grinder known as the D-3 has been placed on the market by the Rotor Air Tool Company, 5,905



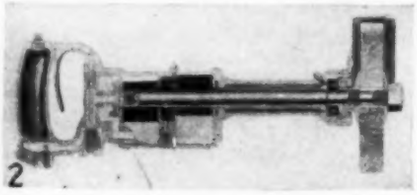


Fig. 1—Rotor D-3 High-Production Grinder. Fig. 2—Cross-section of the grinder showing the construction of the rotor

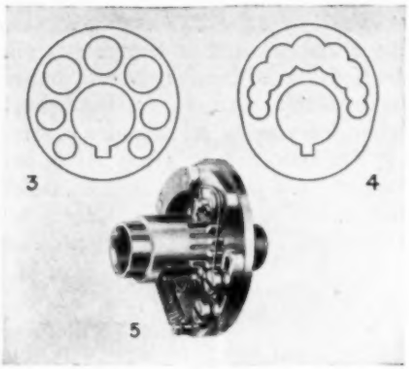


Fig. 3 — Cross-section of the older type of rotor. Fig. 4—Cross-section of the new type of rotor having increased power. Fig. 5—View of the patented rotor governor

Carnegie Ave., Cleveland, Ohio. A view of this tool is shown in Fig. 1, while Fig. 2 gives a cross-section illustrating the construction of the rotor. This machine has been designed for using the above wheels, according to the manufacturer, because production time saved on cast iron amounts to 30 to 50 per cent, on malleable iron from 25 to 75 per cent, and on brass, bronze, and aluminum from 35 to 50 per cent.

The rotor provides a surface speed of 9,000 ft. per min. for 8-in. wheels. A patented rotor governor, illustrated in Fig. 5, has been developed to control this speed, regulating the intake air and keeping the machine at a constant speed of 4,300 r.p.m. when under load. It is claimed that the power of the rotor has been increased considerably by the use of the rotor shown in Fig. 4, in contrast to the older type shown in Fig. 3. This later design is accurately balanced so that the machine runs without vibration, thus preventing the wheels from wearing out of round. A further advantage resulting from this rotor is claimed to be an increased wheel life of 10 to 25 per cent. The D-3 grinder weighs 16 lb. with a guard, and is furnished as standard with either the straight or spade type of handle to meet the requirements of the purchaser.

Apex Full-Floating Toolholders

Both full-floating and self-aligning full-floating toolholders have been placed on the market by the Apex Machine Company, Dayton, Ohio. The full-floating toolholder illustrated in Fig. 1 permits the tool to enter the work on a straight line when the machine spindle and the work do not line up, but their axes are parallel. The device is ball-bearing equipped, and has a total movement of $\frac{3}{16}$ in., or $\frac{3}{32}$ in. each side of center. It is furnished with either straight or Morse taper shanks, and with a bottom to take straight shank tools, Morse taper shank tools, or with the Apex quick-change drill chuck.

A full-floating self-aligning toolholder for use on single- or multiple-spindle operations is shown in Fig. 2. According to the manufacturer, this holder will take care of any angular irregularity between the tool or the work and also allows the tool to float parallel to the axis of the rotating part. The floating parts are ball-bearing equipped and the angular alignment is adjustable. The tool is furnished in several different sizes with straight or Morse taper shanks and with a bottom to hold straight shank or Morse taper shank tools or the standard Apex quick-change drill chucks.

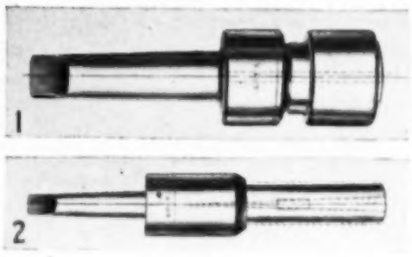
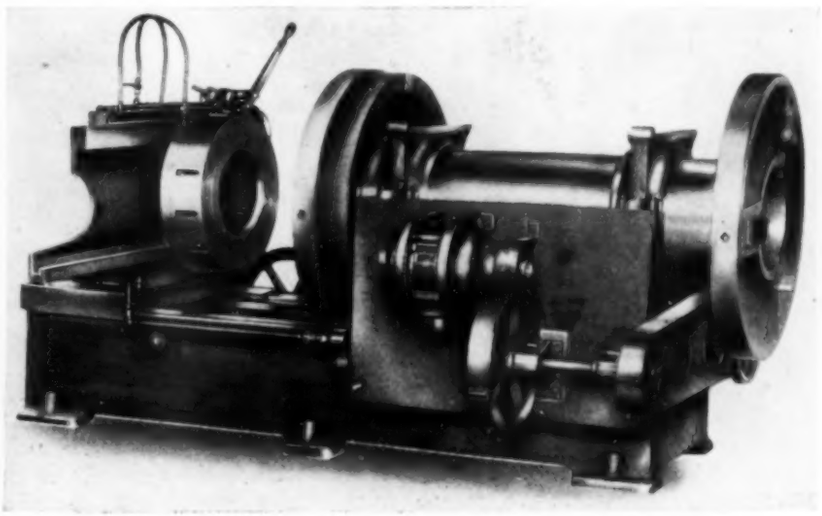


Fig. 1—Apex Full-Floating Toolholder. Fig. 2—Apex Self-Aligning Full-Floating Toolholder

Bignall & Keeler No. 12 Duplex Pipe Threading Machine

INTENDED for oil field work, the No. 12 Duplex pipe threading machine has been announced by the Bignall & Keeler Machine Works, of the N. O. Nelson Manufacturing Company, Edwardsville, Ill. The machine illustrated has a $15\frac{1}{4}$-in. bore through the arbor, which will handle all sizes of pipe, casing and tubing from 4-in. pipe to $13\frac{3}{8}$-in. A.P.I. casing. The large bore gives ample room for passing oversize collars. Eight speed changes are provided through broad-face cut steel gears running in oil in a compact gearbox with one set of gears outside the gear-box. A two-way positive clutch is mounted on the bed shaft. This clutch has both fast and slow positions and provides a quick stop and start for the machine and also enables the operator to shift quickly to the higher speed for cutting-off operations on large pipe sizes.

A three-jaw independent chuck is mounted at each end of the arbor. Either or both of these may be used for gripping the pipe for threading and cutting operations. The rear chuck is equipped with flange grippers



Bignall & Keeler No. 12 Duplex Pipe Threading Machine

for making up and backing off flanged fittings. The carriage has a travel of 33 in., giving ample room for cutting and threading operations. The "Peerless" sliding diehead can be arranged for dies of any desired width. For standard pipe threading work, dies $2\frac{11}{16}$ in. wide are recommended, whereas for D.B.X. and A.P.I. casing and drill pipe work, $3\frac{7}{16}$- and $4\frac{7}{16}$-in. dies, respectively, are recommended. Full length threads can be cut with these dies at one pass, the shape, taper and pitch being accurate. The Peerless dies give a quick change from one size taper or thread to another.

The heavy bed casting rests directly on the foundation, and is strongly braced and provided with suitable mounting for the working parts of the machine. The lower half of the gearbox is a part of this bed casting. Power is furnished by means of a belt or a $7\frac{1}{2}$-hp. motor. Reversing for left-hand threading and pulling collars is accomplished through the countershaft or motor. Cutting-off, beveling and reaming tools are regular equipment.

The belt-driven machine weighs approximately 12,000 lb. and the motor-driven machine 13,000 lb. Floor space required for either model is 76x125 inches.

Olsen Improved Nos. 2A and 3 Motor-Driven Ductility Testing Machines

DETERMINATION of the drawing qualities of sheet metal can be done accurately and rapidly on either the No. 2A improved or the No. 3 direct-connected, motor-driven ductility testing machines developed by the Tinius Olsen Testing Machine Company, 500 North 12th St., Philadelphia, Pa. Both of these machines are automatic in operation, the No. 2A testing sheet stock up to $\frac{1}{16}$ in. in thickness, and the No. 3 up to $\frac{1}{4}$ in. in thickness, without other manual operations than the insertion and removal of the test specimens and the tripping of the controls. Thus the operator is left free to take readings and prepare for the next test, all of which may be done within the time consumed by the cycles of the machines, thus maintaining production at a high level.

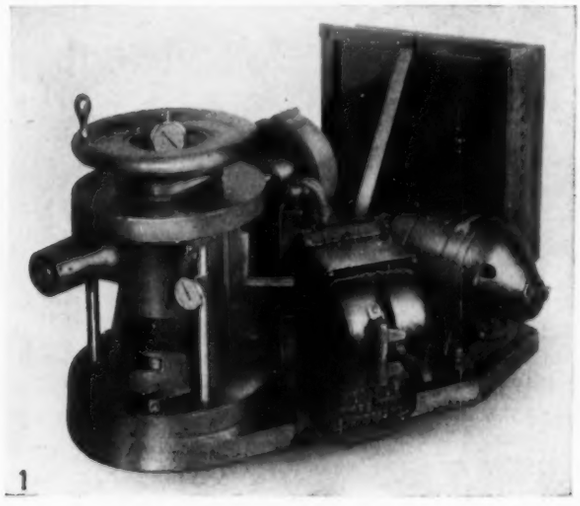
The travel of the cupping tool on these machines is controlled by tripping the proper control. On the return stroke the cupping tool stops automatically at the original position ready for the next test. The travel of the cupping tool for these machines is $\frac{5}{8}$ in. Both machines are driven by fractional-horsepower motors suitable for operation on either a.c. or d.c. circuits.

To operate either machine, the specimen to be cupped is inserted under a die and clamped in place. The standard cupping tool is forced into the material until it ruptures. The depth of penetration is given by means of the small dial above the handwheel, while the amount of pressure exerted on the specimen is given on a dial located on a strain rod in the case of the No. 2A, and on a larger one projecting from the base in the case of the No. 3 machine.

Cupping Samples

The usual practice consists of cupping the metal to a depth of $\frac{1}{4}$ in. and noting the pressure required, after which the test is carried to the rupture point, noting the final load and total depth of draw. Figures so obtained are plotted on rectangular cross-section paper, the pressure to cup to $\frac{1}{4}$ in. being plotted against the total depth of cup at the fracture point. These figures, obtained from several lots of material, are checked against actual machine and die performance by means of which limits are obtained. A diagonal line can then be drawn on the chart, classifying the material as to its performance. This diagonal line is drawn so that all points falling to one side represent acceptable material and all on the other side that which should be rejected. The cupping of the sample is measured to a thousandth of an inch. The pressure is measured to a total of 12,000 lb. on the No. 2A machine and to a total of 35,000 lb. on the No. 3 machine.

For the Nos. 2A and 3 machines, respectively, the lengths are 20 in. and 2 ft. 6 in., and both the widths and heights are 2 ft. 4 in. and 2 ft. 6 in. The weights are 425 and 670 pounds.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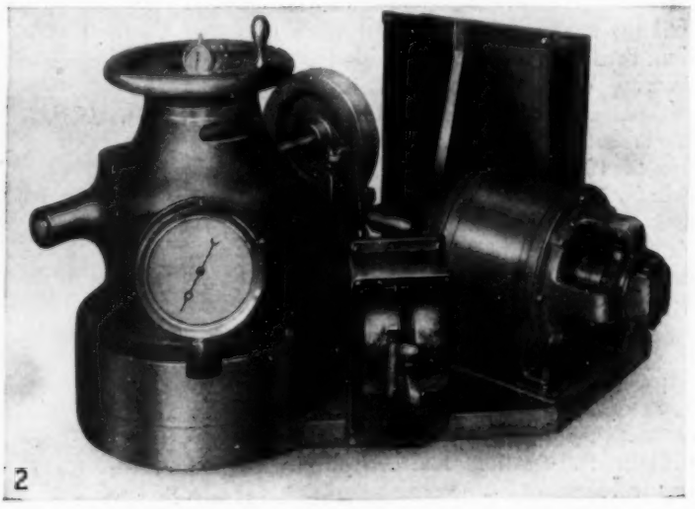
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Fig. 1—Olsen No. 2A Improved Motor-Driven Ductility Testing Machine. Fig. 2—Olsen No. 3 Motor-Driven Ductility Testing Machine

Gardner Hand-Operated Swinging Worktable for Disk Grinders

Whereas by itself a disk grinder will produce only a flat surface without accurate relation to any other surface of a casting, by the addition of the hand-operated swinging worktable shown in Fig. 1, two surfaces can be produced in accurate relation to each other. This worktable has been developed especially for the 30-in. No. 86 disk grinder by the Gardner Machine Company, Beloit, Wis. When the grinder is so equipped it may be used for parts where one face may be ground freehand to get it flat, and the piece then placed in a suitable fixture carried on the swinging table, and a second face ground in accurate relation to the first.

As shown in both Figs. 1 and 2, the table pivots on a shaft carried in a bracket securely fastened to the machine base. The guard ring of the machine is cut out as shown in Fig. 2 to the extent required by the size of the parts to be ground, and it is therefore possible to swing the worktable across the cutting member. Two conveniently located handles are provided for this purpose. By means of the locking hand lever shown in Fig. 2, the table is raised from and lowered onto the grinding

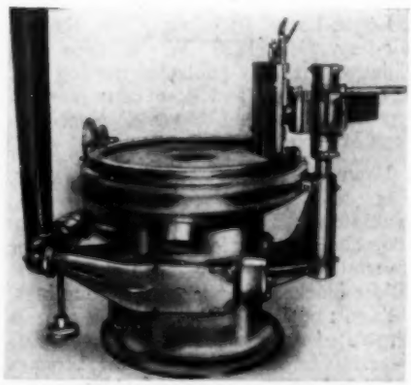


Fig. 1—Hand-Operated Swinging Worktable applied to a Gardner No. 86 Belt-Driven Disk Grinder

wheel, spring tension providing the necessary pressure against the wheel during the grinding operation. When in the normal grinding position, the worktable forms an accurate 90-deg. angle with the surface of the grinding disk. Longitudinal adjustment is available by means of the horizontal slide bar shown, and vertical adjustment is readily obtained by raising or lowering the rocker box on the pivot shaft. The work shown in Fig. 2 is a casting for the crankcase cover of a small gasoline engine, the bottom surface of which is ground freehand and then fixtured so that the side is ground square with the bottom within 0.005 in. The production obtained is 25 pieces per hour, completely ground in the two operations.

The surface of the worktable is

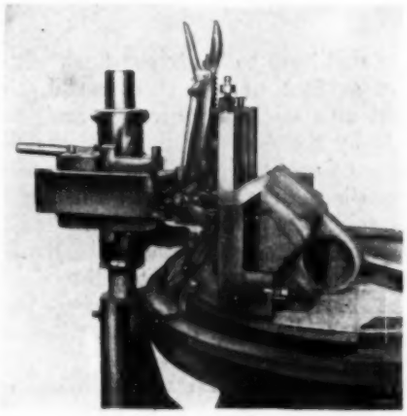
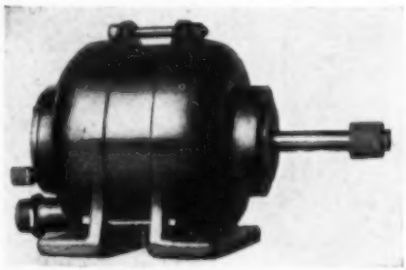


Fig. 2—Close-up from the opposite side, showing the guard ring cutaway and the controls

8x14½ in. and it has three T-slots for ½-in. bolts. These T-slots are 2⅞ in. between centers. Horizontal adjustment of table is 7 in. and the vertical adjustment may be from 0 to 4 in. above the grinding disk. The whole is carried upon a pivot shaft 2¾ in. in diam. This swinging worktable may be applied to either the belt-driven or motor-driven No. 86 grinders.

Forbes & Meyers Diemaker's High-Speed Grinders

Several high-speed grinders in sizes from ¼ to 2 hp., and intended especially for diemaker's use, have been placed on the market by Forbes & Meyers, 172 Union St., Worcester, Mass. Grinders from ¼ to 1 hp. are available for operation at 25,000 r.p.m., while for sizes between 1 and 2 hp. the speed limit is 12,500 r.p.m. By the use of small wheels at these high speeds, the grinders can



Forbes & Meyers ¼-Hp. Diemaker's High-Speed Grinder arranged for operation at 25,000 rev. per minute

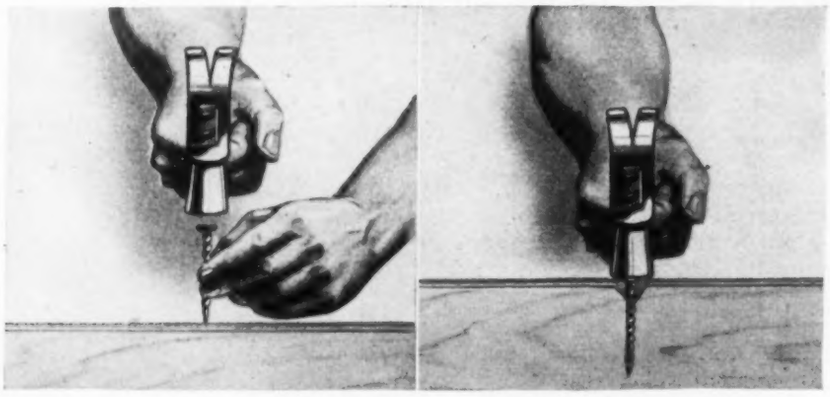
be used efficiently for grinding in small openings, because ample power is assured by the motor sizes. For example, the ¼-hp. model illustrated carries a ¾x¾-in. wheel on a ½-in. shaft, being retained by a ¼-in. screw, while running at 25,000 r.p.m. Spindles may be single- or double-ended at the option of the purchaser.

In these grinders, both the rotor and the wheel are mounted on the same shaft. The rotor is of welded construction to insure a homogeneous mass necessary for safe operation at high speed. The current required for the operation of the machine is obtained from a frequency changer. Current at 60 cycles is put into the machine and 420-cycle power is taken out. This will drive 2-pole grinders at 25,000 r.p.m. and 4-pole units at 12,500 rev. per minute.

Ball bearings are furnished on the spindles of these grinders, and they are lubricated by means of an automatic oil feed. The oil from a small reservoir below the bearing is filtered through a felt wick, from which it passes by capillary attraction to porous disks. These disks lightly touch small rotating cones on the shaft, and these cones throw the oil as a fine mist through the bearing. When the oil reaches the other side of the bearing, it returns to the reservoir. At high speeds a continual supply of oil is very essential, but too much is objectionable. The automatic feed gives the right amount of oil at all times, according to the manufacturer.

Parker-Kalon "Screwnail"

Greater holding power than is possible by means of the ordinary nail may be obtained by the use of a "Screwnail" when fastening sheet metal to wood. This product has been developed by the Parker-Kalon Corporation, 190 Varick St., New



Strong, neat fastenings of sheet metal to wood can be made by means of the Parker-Kalon "Screwnail"

York, N. Y. According to the manufacturer, this Screwnail has four times the holding power of ordinary nails, and its hardened spiral thread and needle-pointed pilot enable it to be driven through much heavier sheet metal than ordinary nails without bending. In many instances, it eliminates the necessity of punching or drilling holes in the sheet metal, as is shown in the illustration. Furthermore, the countersunk head permits the nail head to be driven flush with the surface of the sheet metal, so that an unsightly projection such as left by the ordinary flat-headed nail is done away with. This item combines both the properties of a nail and a screw. It is driven like a nail and holds like a screw, because the hardened spiral thread forms a thread in the burr, formed by piercing the metal, and also in the wood when it is driven.

REVIEW · OF · RECENT · PATENTS

Relating to the Machinery and Metal Products Industries

Metal-Working Machinery

A metal-cutting machine, for gas-flame cutting, was patented, 1,701,661, and assigned to the Linde Air Products Co. In the machine the blowpipe is stationary, and the work is moved and stopped automatically.

A precision thread-grinding machine, patent 1,701,675, was assigned to the Pratt & Whitney Co. In the machine the wheel is mounted on a slide and the saddle on the base. The saddle is driven in one direction in timed relation to the rotation of the table, and the slide is moved laterally at the same time.

A patent, 1,701,183, on gear testing machine was assigned to the Gear Grinding Machine Co. It included a means for carrying and rotating the gear, and a tapered disk to engage with the teeth of the gear and indicate the curvature of the tooth. The same company was also assigned another patent, 1,701,184, on a testing machine on which the gear and a master gear are mounted for rotation and the rotary motion of each gear converted to rectilinear motion so that the differences can be measured.

The American Tool Works Co. was assigned a patent, 1,701,275, on a lathe in which a cam wheel feeds the cross-slide actuating the toolholders on both sides of the work.

An automatic arc-welder patent, 1,701,372, was assigned to the General Electric Co. The welding arc is maintained between the work and a fusible electrode, and the latter is automatically fed toward the work to maintain the welding arc.

Parts and Mechanisms

A patent, 1,701,511, on a lock nut was granted to Martin A. Sisk, of Pittsburgh, Pa. The nut is slotted radially, and a locking sleeve having corresponding projections is slipped over the outer end of the bolt and held by a key.

Gould & Eberhardt were assigned a patent, 1,701,091, on a lubricating system for hobbing machines. The system comprises a reservoir in the casing below the operating mechanism from which the lubricant is pumped to a pan which has outlets leading to the desired oiling points.

A patent, 1,701,673, was granted to Frank B. Howell, of Pittsburgh, Pa., on an attachment for converting a portable drill into a drill press. It consists of a bracket having two guide rods on which a frame slides. The frame has a centering pin in line with the drill located in a projection from the frame.

The Western Electric Co, Inc., was assigned a patent, 1,701,644, on a work-handling device for drilling machines. The device includes a body for holding the part, an automatic clamp, and an ejector operated by compression

A method of building up dies was patented, 1,701,656, and assigned to the Western Electric Co., Inc. It consists of positioning the die parts, placing portions of mounting material adjacent to the parts, and fusing the portions into an integral mantle around the die.

A process for making tapered rollers was patented, 1,701,736, and assigned to the Timken Roller Bearing Co. It consists in cutting up the rod into slugs of the mass required for the rollers, upsetting in a tapered die, and then hardening and burnishing.

Trade Publications

GENERATORS AND EQUIPMENT. The General Electric Co., Schenectady, N. Y., has published three catalogs on generators and their equipment. Bulletin 432-A, superseding 432, takes up d.c. generators and exciters, type CD, available in sizes from 2 to 100 kw. Bulletin 1075 shows temperature indicating equipment for a.c. generators and motors, and Bulletin 1,088 shows battery-charging equipment. Each bulletin is printed on a standard 11½x8 in. sheet.

LOOSE-LEAF BINDERS. The Barrett Bindery Co., 1328 W. Monroe St., Chicago, Ill., has published catalog No. 229 illustrating and describing various types of loose-leaf binders. Specifications of each type are given.

POWER TRANSMISSION APPARATUS. The Standard Pressed Steel Co., Jenkintown, Pa., has published Form 406, showing various types of power transmission apparatus such as hangers, pillow blocks, shaft bearings, couplings, collars, and belt shifters. Each type is illustrated and tables give the various sizes. Various types of steel benches and trucks are also manufactured. The bulletin contains sixteen 11x8½-in. pages.

SAW AND KNIFE FITTING MACHINERY. Samuel C. Rogers & Co. 191 Dutton Ave., Buffalo, N. Y., has published a net price list applying to catalog No. 50-A, effective March 1, 1929. Various types of knife grinders and saw sharpeners are briefly described and the net prices are given. The catalog contains sixteen 7¼x4-in., pages.

News of the Week

Further Details of the New Britain-Gridley Merger

AS WAS announced last week, the consolidation of the New Britain Machine Co., of New Britain, Conn., and the Gridley Machine Co., of Hartford, Conn., has been completed. The new combination, known as the New Britain-Gridley Machine Co., will take over the entire business of the Gridley company and the machine tool business of the New Britain company, which will continue to operate as a manufacturer of screw machine parts, pressed metal products, shop furniture, socket wrench sets and mortiser machines and supplies.

The officers of the new concern are:

President — HERBERT H. PEASE, formerly president of the New Britain Machine Co.

Vice-Presidents—GEORGE D. GRIDLEY, formerly president of the Gridley Machine Co.; RALPH S. HOWE, formerly assistant treasurer of the New Britain Machine Co.; DONALD H. MONTGOMERY, formerly secretary and treasurer of the Gridley Machine Co.; EDWARD L. STEINLE, formerly machinery sales manager of the New Britain Machine Co.; EARL H. WHEELER, formerly vice-president of the Gridley Machine Co.

Secretary—ROBERT S. BROWN, formerly secretary of the New Britain Machine Co.

Treasurer—RALPH S. HOWE.

The directors of the new company, in addition to the above officers, are:

JOHN H. GOSS, vice-president and general manager of the Scovill Manufacturing Co.; ROBERT T. FRISBIE, vice-president of the New Britain Machine Co.; F. G. VIBBERTS, president of the New Britain Trust Co.; P. B. STANLEY, formerly vice-president of the Stanley Works.

Mr. Pease, who is well known throughout the machine tool business will continue as active head of the new concern.

Mr. Brown has been secretary of the New Britain company since its organization and has been responsible for the design of the line of "Super-Production" automatic screw and chucking machines built by that company. He is a life member of A.S.M.E. and is widely known as an engineer.

Mr. Gridley's experience in the machine tool business covers a period of over thirty years. He is well known among users of screw machines throughout this country and abroad. For the past two years, Mr. Gridley has been active head of the Gridley Machine Co., where he developed and built single- and multiple-spindle automatic chucking machines of unconventional design. His efforts will be devoted entirely to designing and building new machines at the New Britain-Gridley Machine Co. The new company will continue to build and market the machines previously built and sold by the two old companies.

Mr. Steinle, also well known in the trade, will act as sales manager for the new company. John H. Goss, chairman of the board of the New Britain-Gridley Machine Co. is also chairman of the board of the New Britain Machine Co. and vice-president and general manager of the Scovill Manufacturing Co. of Waterbury, Conn. Mr. Howe, treasurer of the new company, has been associated

George D. Gridley
Vice-President, New Britain-Gridley Machine Co.

with the New Britain Machine Co. for many years in a financial capacity.

Mr. Montgomery has had several years experience in the automatic screw machine business not only in sales but also in engineering fields. For the last two years he has been an officer and active in the Gridley company. Mr. Earl H. Wheeler has had a practical experience in the manufacture, design, and tooling of automatic screw machines over a period of twenty years, and has been active along these same lines in the Gridley company.

The offices and manufacturing facilities of the new company will be those formerly used by the New Britain Machine Company.

Machine Shop Practice Meeting in Chicago

More than 400 engineers and factory executives attended the annual machine shop practice meeting of the Chicago Section of the American Society of Mechanical Engineers, held jointly with the Western Society of Engineers, in the Engineering Building Auditorium, 205 W. Wacker Drive, Chicago, on March 18. Four papers were read as follows: "Center and Centerless Types of Cylindrical Grinding," by R. E. W. Harrison, of Cincinnati Grinders Incorporated; "Practical Applications of Nitriting Steel," by H. W. McQuade, metallurgist, of the Timken Detroit Axle Co.; "The Possibilities and Limitations of Carboloy in Higher Speed Cutting," by G. N. Seeger, of the Carboloy Co., Inc.; and "Determining the Physical Properties of Steel by Magnetic Methods," by A. V. deForest, of the American Chain Company.

The meeting included an afternoon and an evening session, with a dinner served between sessions at the Bismark Hotel. Frank W. Curtis, Western Editor of *American Machinist*, and Harold Greenhill, of William P. Greenhill & Son, acted as chairmen of the respective sessions.

Net Profits of Industry Rise 20 per Cent

Total net profits of 1,042 companies in 38 business groups amounted to $3,748,051,000 in 1928, an aggregate gain of 17.19 per cent over 1927 figures, and of 11.35 per cent over 1926 figures, according to a compilation prepared by Ernst & Ernst, accountants, from published financial statements. For 815 industrials, the compilation shows an aggregate increase in earnings over 1927 of 20.49 per cent; for 120 public utilities, an increase of 18.7 per cent; for 82 railroads, 9.90 per cent, and 25 financial institutions, 70.36 per cent.

Of the 815 industrial concerns, 516 were up and 299 down. In the machinery and tool group, out of 55 companies reporting, the net gain over 1927 figures was 21.92 per cent, despite the fact that sixteen of the companies showed lower profits. In the miscellaneous metal product group the gain was larger, being 30.44 per cent over 1927 figures, 25 companies reporting. Twelve automobile manufacturers showed a gain of 19.67 per cent; and 27 automobile parts and accessories manufacturers, 60.86 per cent. About the same per cent increase was shown by eleven concerns making brass and copper products.

In the metal-working field, the greatest loss in net profit over 1927 figures was shown by railroad equipment manufacturers, with an average net decrease of 25.52 per cent. Out of sixteen concerns in this line eleven reported profits under 1927 figures.

Automotive Production

February production (factory sales) of motor vehicles in the United States, as reported to the Department of Commerce, was 466,084, of which 407,589 were passenger cars and 58,495 trucks, as compared with 400,715 passenger cars and trucks in January and 323,796 in February, 1928.

French Economic Adjustment Hampered by Rising Price Scale

By Our Paris Correspondent

THE outstanding feature of French activities is the general tendency towards rising prices. With food stuffs approaching the index figure of 600, the producing labor finds itself far below meeting the issue with the present wage scale. The manufacturing employer, distributor and retailer claims to be carrying all the load that is properly his. At that, the February price index of metal manufacturers was actually three points under that at which it stood the last of November.

Meanwhile the general group of 25 industrial materials has risen from 678 to 683, and twenty food stuffs from 595 to 599. National products have increased 8 points while imported products have fallen 2 points. The difficulties appear to be of domestic origin as suggested by these figures, due perhaps to a certain political unrest in view of the possible fall of the Poincaré cabinet.

Should a cabinet change be made and should the German reparations accord and the debt question as a whole bring about a solution wherein French expectations are not fully met, a critical and insistent readjustment period will really have arrived. It is already looming on the horizon.

It will be doubtful then if there is much chance of American machinery exports to France increasing 40 per cent as they did in 1927 and it will be equally improbable that French exports will hold to their even diminishing level, and unlikely also that sales in the domestic market will hold up to scale.

The late influx of American high-production machinery, and to a lesser extent that from Germany, has speeded up French makers to meet the competition with an effort which is commendable and has produced some results, but it would appear that the French manufacturer may run into financial and economic troubles.

It may be said that the exceedingly rigorous winter has had a considerable effect upon all basic and heavy industries, and for a period of two months has slowed down output to proportions that will require an irrational activity in many metal-working industries to catch up before the end of the year.

Industrial production of France as based on the figure of 100 in 1913 and brought down to January, 1929, shows an index as follows:

	Nov.	Dec.	Jan.
General production	131	132	134
Mechanical industries	143	143	149
Automobile	562	599	657
Metallurgy	125	130	133
Textiles	96	100	99
Mines	120	122	119
Building	110	98	96
Rubber	629	637	618

The Franco-German current tariff accord is revisable within sixty days after March 31. This may affect in an untoward manner machinery imports and bring a like movement respecting those from the United States. It seems unlikely however, that any further concessions will be granted. French opinion generally is to the effect that the Franco-American customs agreement of 1927 (parity with that between France and Germany) has accorded nothing or nearly nothing to France in return. It may be that French exporters to the United States since that time have not been sending out goods which fitted in with the prescriptions of the accord and thus no great showing has been made on items on which specific concessions were granted.

In spite of the frankly protectionist policies of France, American machinery and American automobiles are coming in in greater volume and value than ever before. The import of American automobiles in 1928 was 45 per cent of the total French import from all countries and an increase of 4,360 units over 1927. No real concession was accorded American product in these lines, and yet the French automobile production index now stands at 657, as compared with 100 for 1913.

On December 31, 1928, a deficit was indicated in the foreign commercial exchanges of France to the value of more than 2 billion francs and a diminution in the value of exports of 3.5 billion francs. The home market has doubtless absorbed more manufactured consumer goods than in the year previous, and exports, for that reason or another, were less. More manufactured goods, though not all consumer goods, as in the case of machinery, came from abroad to cater to this same market, and French industry of itself had less of a surplus for export abroad. This is the economic explanation which is far more acceptable than any financial reasons which may be conjured up. As an illustration French automobile imports, chiefly American, increased 84 per cent while exports fell off in the neighborhood of 15 per cent.

The part played by Franco-American trade relations is interesting.

	1927		1928 (10 Months)	
Imports from U. S.	Metric Tons,	Value, Francs	Metric Tons,	Value, Francs
Machinery and parts	19,069	293,076,000	13,152	317,562,000
Tools and Mfrs. of metal	2,913	71,985,000	2,180	52,737,000
Exports to U. S.				
Machinery and parts	1,261	18,637,000	1,265	15,588,000
Tools and Mfrs. of metal	45,475	96,722,000	38,650	68,439,000

It is significant that French exports of "Tools and Mfrs. of Metal" are so great in volume in the respective years but this French customs classification includes items so classified that they have little relation to machinery or tools *per se* and probably include heavy shipments of cast-iron pipe which have been made in recent years to America. Another comparison of importance is to be arrived at by citing the value per ton of this latter classification, 1,800 to 2,150 francs, which would indicate that it was not tools that predominated, as the valuation under the same classification of imports from the United States was from 24,000 to 26,000 francs per metric ton. A similar even higher figure of comparison is shown in favor of American machinery imports in relation to French exports.

The rumor that Ford was actually to set up a producing plant in France, replacing the present assembly plant, has been received in French circles with about the same proportion of awe and wonder as was caused by the announcement that the Pont-a-Mousson Foundry was to install an American cast-iron pipe plant in Massachusetts. American exports of agricultural machinery to France fell off in the year past to the extent of 60 per cent, because the French market now is being so largely supplied from the plant of the International Harvester Co. in northern France. Growth of this practice is foreseen.

If there is any specious comment to be made on the French machinery and tool industry at this time it is chiefly that its sphere of action is not widening as was hoped, though there is a growing disposition on the part of small machine shops to renew and add to equipment. To this extent the situation is encouraging; it may suggest that the end of American machinery exports to France is still further removed than might otherwise be the case had not American production methods made the impress that they have.

A notable event the past month in the French automobile industry has been another combining of forces by the Delahaye and Brasier firms with the obvious object of increasing production and distribution efficiency. A rumor that Hotchkiss and the Lorraine-Dietrich automobile industries were to combine has brought forth from the latter concern a statement to the effect that no such procedure was contemplated save as the French government might ordain that makers of aviation motors should work to standardized designs for certain details, in which case they were ready to conform.

Banking interests are believed to be on the point of starting an automobile war in which are mentioned the Citroen and Peugeot firms, each backed by opposing financial resources which promise to make things lively to the extent that production methods of each of these comparatively big output plants will have to be trimmed down to the limit of efficiency. How the Renault Co. will view this and what their reply will be is still a matter of conjecture.

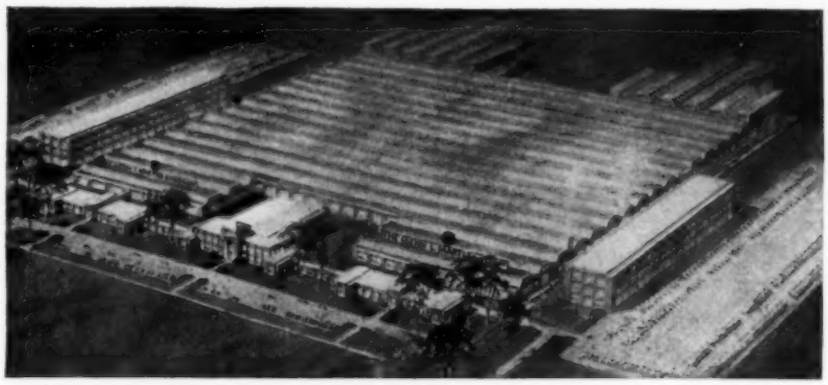
The automobile industry here, from its distribution if not its production point of view, appears to be much

concerned by the unfounded rumor that General Motors is to produce the new six-cylinder Chevrolet for the European market in the Opel plant at Russelsheim, Germany, and that this can be thus put on the French market at 26,400 francs, which is less than the price of any close-competing French four-cylinder car.

The low French labor wage (nominally one-fifth of that of the United States) is apparently not sufficient in this case to meet that of Germany or the highly efficient machine production of America when reducing consumer prices to a gold basis. Citroen's six-cylinder model still sells in France at the equivalent of $1,400; the new Chevrolet at but little more than $1,000, if the above given figures which are so shaking the foundations of the French industry are held to.

Martin to Build Huge Airplane Factory at Middle River, near Baltimore

GLENN L. MARTIN, pioneer airplane manufacturer, has selected Middle River, Md., ten miles from the city of Baltimore, as the site for an airplane manufacturing plant and airport. The property is located on the main line of the Pennsylvania Railroad and only a short distance from the parallel line of the B.&O. With the land and equipment, the first unit will cost about $2,500,000, and work will begin at once. The remaining two units, which will triple the size of the factory, will be completed within three years.



Proposed plant of the Glenn L. Martin Co. at Middle River, Md.

The total area under roof, which includes the main plant and auxiliary buildings, is 22 acres. The entire tract has 1,200 acres, 1,000 of which will be devoted to the airport. The factory proper will be located on the highest elevation of the tract. The main plant, when completed, will be 1,080 ft. long and 900 ft. wide, and the first unit consists of an office building 46x202 ft., and a manufacturing plant 300x930 ft. This first unit will be completed by September.

Roof Span 100 Ft.

The illustration shows the entire proposed construction. The plant will be of masonry and steel construction throughout, with double sawtooth roof construction, for assuring plenty of light. The roof is supported by 100-ft. trusses to keep the floor area free from columns the full length of the building. The final assembly department has a clear flow area of 125x278 ft. All materials will be moved through the plant by means of a monorail system, having a total length of 1½ miles.

Equipment Installation

It is planned to install modern equipment and production methods to facilitate production of airplanes of new design. Special consideration will be given to the machinery in the tool making department and the machine shop proper. The heat-treating department will be equipped with electric air-bath furnaces for handling sheets of duralumin up to 40 in. wide by 15 ft. long, and the sheet metal department will be equipped with a large variety of presses for handling duralumin parts. The welding department will be completely piped with various gases generated at the plant. In the factory there is also a physical and chemical laboratory for testing materials. In the finishing department, which is to be located between the manufacturing department and the main assembly floor, spraying equipment will be used almost exclusively. The final assembly department will be arranged and located so that the center of this department is adjacent to the main finished part stock room.

It is expected that within a year 2,500 persons will be employed, and when the whole program of construction is completed, 10,000 men will be required. At the present time the Martin company is operating in Baltimore in the Colgate Warehouse No. 2 of the Canton Company.

Chicago to Have Machinery Mart

Chicago is to have a Machinery and Equipment Mart ready for occupancy May 1, 1930. The building will be located at Canal, Monroe and Clinton Sts., covering a full block in the center of the machinery district. The building will contain approximately 500,000 sq.ft. of rentable floor space, and it will rise sixteen stories above the street level. The building will be of fireproof construction, designed to sustain the weight of any machinery or equipment on display. The exterior of the building will be of terra cotta from grade to the fourth floor line, and face brick above that, set-backs being used to enhance the architectural beauty.

The building will house a club and an auditorium capable of seating 750 people for use in trade conventions and association meetings. A garage is furnished in the rear of the building. Another feature of the building is the arrangement of corridors showing a continuous line of plate glass windows, displaying machinery and equipment assembled in the various spaces. All necessary electric connections will be provided for the operation of machinery or equipment as may be desired.

The building is being constructed by a syndicate headed by Ivan P. Florsheim, of Chicago. Men in the machinery line will be chosen by the tenants to compose the board of governors.

Westinghouse Reports Big Gain in 1928 Net

The business of the Westinghouse Electric and Manufacturing Company during the year 1928 was the best for any twelve months in its history, according to the company's annual report, which was made public recently. Sales billed for the year were $189,050,302, and net income was $20,814,940, which figures exceed previous records by $3,500,000 and $2,700,000, respectively. Owing to a change in the fiscal year, which now ends December 31, instead of March 31 as heretofore, the present report covers officially only the nine-months period extending from April 1 to December 31, 1928, but the figures given above are for the entire year of 1928 in order to provide a basis for comparison with previous full fiscal years.

The company's total current assets are given as $135,679,223 (a gain of over $13,000,000 in nine months), and its total current liabilities are $17,000,000. The surplus is now $67,000,000, a gain of $10,000,000 in nine months. The value of unfilled orders on December 31, 1928, was approximately $47,000,000. During the nine-months period the value of orders received exceeded by almost $20,000,000 that of the same period in 1927, due largely to the increase in demand for radio products and industrial motor apparatus.

BUSINESS BAROMETER . . . . *It is quite likely that the present huge industrial output is causing an accumulation of stock that will cause trouble later*

By THEODORE H. PRICE
Editor, Commerce and Finance, New York

From this page the reader will get a quick picture of current business and industry. The boxed material below is a summary of the letters from regional correspondents of the American Machinist, published in full on the opposite page.

CREDIT, often miscalled money, is the lifeblood of business, and a sanguine view of the commercial and financial future is directly dependent upon the supply of lendable funds that is available and the rapidity with which they circulate. Just at present the world's demand for capital seems to have absorbed the floating supply, and business is commencing to suffer from anemia, although the impetus that it acquired some months ago is still felt. But the automatic contraction in the supply of lendable credit is making itself felt everywhere, and unless some extraordinary expedient is adopted a gradual liquidation appears to be inevitable.

Among the extraordinary expedients suggested is one coming from some of the confreres considering the reparations problem in Paris. This suggestion contemplates the creation of what might be called a bank of all nations, in which the world's supply of gold shall be deposited and used as the basis of the issuance of credit obligations when justified. If adopted, it might usher in another era of inflation that would carry prices even higher than they are at present.

Among the factors that are in the foreground of the present situation, the most important is the continued talk of an advance in Federal Reserve rediscount rates, stimulated by another increase in acceptance rates last week, and the inaction of the authorities in whom the power to raise the rates is vested. The speculative fraternity seems to have become indurated to the repeated threats of higher interest rates, and is disposed to continue buying stocks without regard to the cost of carrying them. Thus average prices are now about as high as they were when the Reserve Board's warning was issued on February 6, and despite all the efforts to check lending on securities, brokers' loans in New York increased $166,000,000 last week to a new high, which is $124,000,000 above the previous peak.

Of course, an end to this process must come some time, but it now appears unlikely that it will be a direct result of any action by the Federal Reserve authorities and we must wait for the operation of natural law as manifest in the rate for call money paid on the New York Stock Exchange from day to day. It seems unlikely that even the most optimistic speculators can long remain insensible to the high cost of carrying stocks.

Then there is the persistence with which the stock brokers are demanding increased margins. Many of them have insisted that the stocks they are carrying shall be marked down to figures that are less than half or a third of their present value, and the pressure thus exerted must in time work a reduction in the debit balances. A majority of the Wall Street traders have come to believe that these influences will ultimately be more effective in checking the excessive speculation in the stock market than all the mouthings of the Federal Reserve authorities.

And finally there is the possibility that business activity will soon begin to recede from the peak that it has reached. The stock speculation is more vulnerable to attack from that direction than from any other, and even those who believe that it will remain impervious to the cost of credit admit that it could not long survive indications of a decline in commercial and industrial activity.

Thus far no sign of such a recession has appeared except in building. On the contrary all the other major industries and most of the minor ones are working at rates that exceed any they have ever reached in the past. This is true of the automobile and tire factories, and the iron and steel mills. All these industries report a demand for their output that will keep them busy for several months to come.

Difficulty in obtaining goods for quick and fast shipment is a problem that American business has not had to contend with for a long time. If it should become pronounced or widespread, the policy of hand-to-mouth buying will probably be abandoned and a scramble ensue that will make goods scarce temporarily.

But an actual shortage of commodities in the United States is unthinkable as long as the capacity of our factories so much exceeds consumptive needs, and it is more likely that the present huge output is causing an accumulation of stocks somewhere between the producer and ultimate consumer that will compel a decline when they become visible.

Thus the automobile industry is thought to have made over 500,000 cars in March and about 1,400,000 in the first quarter. This is at the rate of 5,600,000 for the year, and the rate at the opening of the second quarter exceeds 6,000,000 a year. As not even the most optimistic observers expect that much over 5,000,000 cars will be sold this year, a curtailment of production within two or three months appears inevitable.

With building already lagging, such a recession will communicate itself to steel and thence to other industries. The decline in rubber prices last week may be a warning of it, because it reflects a realization that the present rate of consumption probably cannot be maintained. Not much of a business recession will be required to turn the stock market downward, and, as it is so clearly within the possibilities for the second half year, no one should become so anesthetized by our present prosperity as to ignore it.

A STEADY, large volume of orders for one or two items features the machine tool market all over the industrial country, and present indications, almost without exception, are that March will be another record-breaking month, despite the fact that February proved to be the best month, as far as volume of sales went, since 1919. Business for the quarter, when totaled, will be excellent.

ENOUGH orders are now booked ahead to keep the machine tool builders busy for many months to come. As has been the case for some months, the chief complaint is the scarcity of skilled machinists, even in such centers as Milwaukee, where a progressive apprentice policy has been in effect for many years. In other centers, such as Cleveland and Cincinnati, the complaint is made that the higher wage scale of the automotive shops is attracting the best men from the machinery trades.

AUTOMOTIVE buying features the market in many industrial centers, but it by no means furnishes the bulk of the orders for shop equipment. In fact, all kinds of metal-working industries and all kinds of shops, both large and small, are in the market for equipment, producing what is termed a healthy condition all over the country. Railroad purchases so far have not materialized in any volume, but a number of the roads have issued lists against which they will buy in coming months. The seasonal demand for contractors' equipment makes this branch of the machinery trade hopeful of an active spring.

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The Industrial Review

Weekly progress of the machinery and machine tool business

THE following reports, gathered from the various machinery and machine tool centers of the country, indicate the trend of business in these industries and what may be expected from the future:

NEW ENGLAND

As accurately as can be judged, the past week in the New England section was less fruitful of orders than its predecessors in March. A high level was, however, maintained. There was an absence of orders calling for a number of units, but no let up was apparent in the flow of orders for single machines of all kinds and sizes. The very large volume of this class of business from many sources exemplifies a very healthy business condition.

Spring has quickened the demand for road building machinery and tools. New England construction programs for permanent pavements are very heavy, particularly in Massachusetts, Maine and New Hampshire. The latter state has voted $8,000,000 for this purpose.

Dealers in used and rebuilt equipment are short on some items of machinery. The best conditioned and most modern tools in this field sell readily, and the keen demand from small factories, shops, garages, and the like for the past several months has cut sharply into the available supply, hence the shortage. One dealer reports sales in greater volume for the first three weeks in March than for the entire month of February.

PHILADELPHIA

Reports from machinery and machine tool manufacturers throughout the Philadelphia district showed that business during the last fortnight has kept up to expectations. One dealer reported business to be about 15 per cent ahead of what it was at this time last year. Sales have been steady and cover a well scattered area. Inquiries have been of a substantial nature and indicative of early orders. There has been a brisk demand for small tools, particularly from the Middle West, and there have been some substantial sales of shop equipment to industrial lines and a few to railroads.

The market noted some inquiries from aircraft producers. The Reading Co. and the Pennsylvania Railroad Co. have made some inquiries for shop equipment. There appeared to be a lack of response from the automobile industry. Manufacturers of instruments for testing metals reported that business has been holding up very well, and a similar report came from a leading manufacturer of leather belting. Twist drills and other equipment of a similar nature have been selling satisfactorily.

MILWAUKEE

Comment on the machine tool situation continues to have a satisfactory tone, the demand being well sustained in all quarters, and inquiry of a character suggesting the further continuance of active buying for some time to come. The fact that the bulk of orders consists of single items, and that sources of business still cover almost the entire field of metal working, remains as one of the most gratifying features of the situation, and is accepted as testimony that the state of the industry is a most healthy one.

Little progress has been possible toward balancing deliveries with shipping specifications, because of the stress of labor shortage. Most tool plants are operating at a rate limited only by the ability to procure labor, although it is true that the majority have reached the limit of capacity as well. New construction is held in abeyance because of both the labor shortage and the exercise of caution as to a permanent need of additional capacity, which is well warranted at present but might later become an expensive burden. Meanwhile, every resource is being put into play to bring about a maximum output.

Local industries, which during 1928 made cumulative equipment purchases that established a new record, continue to be good customers of the tool industry, here and elsewhere. The A. O. Smith Corporation contemplates another large extension to its electrically-welded products division.

Were the local demand limited merely to replacements, there still would be a large volume of business. In fact, acquisition of equipment for this purpose represents the bulk of the demand, judging by the predominance of single tool orders being placed. Every effort is being made to compensate for the lack of manual labor by the installation of labor-saving devices. Special multi-purpose tooling is in demand as never before.

BUFFALO

Apparently March will not measure up to January and February with reference to business done in the machine tool trade throughout the western New York district. A slowing up in inquiries and demand was somewhat noticeable two weeks ago, as then noted. In addition, the needs of the aircraft industry seem to be well cared for at present. There are rumors of new models to be produced by the Consolidated Aircraft Corporation and the General Airplanes Corporation, the latter being particularly active. But neither of these companies makes its own motors. Furthermore, few railroad equipment orders are coming into this district at present, although a few items were bought earlier in the year.

The sudden breaking of winter has given additional interest to contractors' activities and this will doubtless be reflected in increased business within the next two weeks. Several important projects will be started this spring.

CINCINNATI

With very few exceptions the machine tool manufacturers of the Cincinnati district report that sales held to a good level in the past week. The small number who did less than in the previous week state that the loss was of no great consequence and regard the condition as merely a temporary lull. All have enough business booked to keep their plants busy for some time to come, and for this reason weekly fluctuations in sales are not affecting manufacturing activity.

Typical comments made by manufacturers were in substance as follows: "Business is so good with us that we do not see how the demand can become any greater." "Business is at an excellent level, inquiries are flowing in freely, and the prospects for the continuance of the present good demand seem bright." "We are having a good demand and business is well balanced and running on an even keel." Selling agents report that the week's bookings were satisfactory, and state that the market in local and adjacent territory is showing many signs of becoming still livelier.

The week's sales were well scattered over the different sections of the country, the sustaining feature of the market being the purchase of single tools and replacements by general machinists and miscellaneous users, whose requirements were well diversified in the matters of sizes and types. Sales to concerns in the automotive industry and to railroads were largely confined to single tools and replacements. A large number of inquiries were received during the week.

INDIANAPOLIS

Business in machinery and machine tools in this territory continues to expand. In fact it may be said that in many lines the demand is becoming exceptionally good. Manufacturers and dealers here say that, if the month continues as well as during the first three weeks, business will be better during March than during January and February. In almost every line of industry using tools or machinery, there has been a decided improvement.

Automobile factories are very active. For example the Marmon plant is in production for a new car to sell at about $1,000. The plant is turning out 150 a day in addition to the regular cars already on the market. The plant is a regular purchaser of machinery and tools. Reports from the Chrysler and Studebaker organizations show that production is heavy. The same may be said of the Auburn plant, which recently purchased additional property at Connersville, Ind., and made many replacements and new installations.

The coming of the building season has increased the demand for contractors' equipment. At present most of this equipment is for road building work, and the demand is much heavier than it was this time last year. The construction machinery demand for buildings, while increasing, is biding the coming of warmer weather.

Radio factories are particularly busy. This applies also to the cabinet factories. Sales of special wood-working equipment to these plants are very heavy. Just recently one cabinet plant at Bloomington, Ind., received an order for $12,000,000 worth of cabinets. The order was so large that it was divided up among four factories in Indiana. The order is said to be the largest single order for radio cabinets ever contracted. This is indicative of the entire trend of industry in this state. No wonder the machinery and tool men are optimistic. Many of them say the outlook for business this year is the brightest in history, not even excluding the "boom" times following the war.

Railroads are placing some orders, mostly to be used in repair shops.

CLEVELAND

Conditions in the machine tool industry in Cleveland are on an excellent level. Increases in orders and new inquiries for the past ten days are generally noted. The automobile demand has toned down considerably, although still in good volume, but this is offset by a more general buying by diversified lines. A year ago large lists predominated, to-day the average is one or two tools, the aggregate of which totals as much in dollars and cents as last year.

The first quarter of this year promises to be better than any quarter of 1928. February, a short month, gained over the previous month, an active one, by a wide margin. March to date is exceeding the two previous months on a steady increasing scale. Increased industrial production has helped the present machine tool prosperity. Automobile production is the leader in toning up business, and local manufacturers

of parts for the automotive industry see a record year in prospect. Bookings of orders for a local spring and axle concern are running a $1,000,000 higher than last year.

Manufacturers of automatics and punch presses have increased production in order to expediate unfilled orders. Machine tool manufacture in general is being seriously handicapped by the shortage of skilled mechanics. According to public employment offices a 20 per cent increase is noted in the number of positions filled during the last month.

The Cleveland Board of Education has a list of twenty tools out for woodworking and metal shops of two new high schools.

NEW YORK

Little change has taken place in the machine tool market in the metropolitan district in the last week. Orders continue to be received from a wide diversity of sources, and while few of them call for a large number of items, the aggregate volume is large. It appears that March business will be comparable with that of February, which was a record-breaking month for many of the local dealers and factory representatives. Even the small job shops are modernizing their equipment or expanding their facilities, some with expensive equipment such as jig borers, indicating that the overflow from the big plants is being "farmed" out. It is said that the General Electric Co. is resorting to this practice for the first time in its history.

Another significant condition at the present time, when talk of credit is so much in the air, is the fact that bills are being discounted within a shorter period than ordinarily, according to the experience of a leading dealer.

While orders in general have been in small lots, the aggregate purchases by the General Electric Co. have been large. Another large purchaser has been the Victor Talking Machine Co., the chief item bought being presses, and in the coming month the Intertype Co. of Brooklyn, will feature in the buying. In moving into new and larger quarters, the company will purchase a large variety of shop equipmment. One large order, said to total $40,000 and reported in the past week came from the Worthington Pump & Machinery Co. for its Holyoke plant. It included a 5-in. horizontal borer.

Sales made by the Triplex Machine Tool Co. in the past week included: a Swiss jig borer, two 14-in. shapers, an Oesterlein milling machine, an Oesterlein cutter grinder, and a Boley multiple-spindle drilling machine.

CHICAGO

Practically no change from the conditions noted a week ago is reported by dealers and distributors of machine tools in the Chicago market. The business coming in still is from widely distributed sections, with the Chicago territory a prominent factor in the aggregate of sales. From all indications, business for March will fully equal the record set by January and February. Inquiries appear to show no falling off, and are for tools of all types, large and small.

The Chicago, Burlington & Quincy and the Chicago, Rock Island & Pacific railroads are in the market for new shop equipment, some of which is for heavy-duty work. Closing by such other roads as have submitted lists is said to be making but little headway.

In the main, deliveries still continue backward, although some plants are gradually catching up with orders and expect to reach normal conditions before spring is over. Automotive and automobile accessory plants are doing considerable buying, and tractor builders continue to inquire for needed equipment, but the necessities of general industry and machine shops constitute the mainstay of the market at this time. Used tools continue in good demand, and bring uniformly satisfactory prices, particularly for reconditioned units of standard make.

Crucible Patents Acquired by Krupp Nirosta

The Krupp Nirosta Co., Inc., has purchased from the Crucible Steel Co. of America the three Johnson patents covering the analysis and manufacture of Rezistal, a corrosion- and heat-resisting steel. The Crucible company has acquired an interest in the Krupp Nirosta firm, which had previously acquired some of the Ludlum patents and the Krupp heat-treating patents covering Nirosta steels.

The Crucible Steel Co. is now licensed to manufacture under all patents controlled by Krupp Nirosta Co., which also licenses the Central Alloy Steel Corporation, the Ludlum Steel Co., the Babcock and Wilcox Tube Co., the Firth-Sterling Steel Co., the Lukens Steel Co., the Wallingford Steel Co., and Spang, Chalfant and Co. These companies automatically receive rights to manufacture or fabricate under the Johnson patents.

Business Items

The Wisconsin Axle Co., Oskosh, Wis, a subsidiary of the Timken-Detroit Axle Co., has been organized to take over the assets and continue the operations of the Wisconsin Parts Co. following its consolidation with the Timken-Detroit Axle Co. Operations of the company will be in charge of: Walter F. Rockwell, vice-president and general manager; A. H. Chatley, secretary-treasurer, and B. W. Keese, chief engineer. The Wisconsin Axle Co. will continue to manufacture double-reduction axles for motor trucks and buses, worm-drive axles and transmissions, and axles for farm tractors.

The Ross Gear & Tool Co., Lafayette, Ind., had earnings for the first two months of 1929 that exceeded the earnings for the entire first quarter of last year, according to Edward A. Ross, president. No earnings were published for the first quarter of 1928, but in the first months of the year the company reported net income of $373,962, or $2.48 a share on the 150,000 shares of common stock outstanding. The statement by Mr. Ross indicates that the first six months of 1929 should run ahead of last year.

G. Elias & Bros., Inc., of Buffalo, manufacturers of furniture, have formed the Elias Aircraft & Manufacturing Co. to engage in the production of sport and military-type monoplanes. The craft will be built at a factory on a site adjoining the Buffalo airport. The plant will have approximately 127,000 sq.ft. of floor space, and will have a capacity for producing 30 airplanes a month. The company is also said to be developing a new engine, an air-cooled type, having four cylinders and developing 80 horsepower.

The Roller-Smith Co., New York, N. Y., has appointed the Manila Machinery & Supply Co., Inc., Manila, P. I., as representative in that territory. Jackson Brown, Jr., 701 Kittridge Bldg., Denver, Colo., also has been appointed representative of the company in Colorado, Utah, Wyoming and northern New Mexico. Both of these representatives will handle the company's line of electrical measuring instruments, relays and circuit breakers.

The Cincinnati Milling Machine Co., Cincinnati, Ohio, is building a new assembly and shipping building at Oakley at a cost of $125,000. It is expected that this addition will increase plant efficiency by further facilities for straight-line production. It is to be a one-story steel frame building, 140x250 ft. with a monitor. When it is completed, the number of employees will be increased from 1,200 to 1,300.

General Motors of Canada has acquired 93 per cent of the stock of McKinnon Industries, Ltd., one of the oldest manufacturers of motor car parts and accessories in Canada, according to R. S. McLaughlin, president of the former concern and now chairman of McKinnon Industries. Mr. McLaughlin said that the change in ownership will not affect present business of the company.

The Cadillac Motor Car Co. has started to expend $5,000,000 on building and equipment, in line with the program of the General Motors Corporation for expansion all over the world, it was announced by Lawrence P. Fisher, president. The new building program will give Cadillac an annual capacity of 60,000 cars, or 50 per cent more than its present production.

The Western Electric Co. is in process of building a factory at Point Breeze, Md., at a cost of $22,500,000. According to Edgar S. Bloom, president, 30,000 people will ultimately be employed in this plant or more than 5,000 more than are now employed in the Hawthorne Works of this company. The plant will be largely devoted to cable manufacture.

The Barber-Colman Co., of Rockford, Ill., has appointed two new agencies in the California territory: the Herberts Machinery & Supply Co., 401 E. Third St., Los Angeles, and the Herberts-Moore Machinery Co., 140 First St., San Francisco. Both companies will handle milling cutters and hobs as well as hobbing machines and hob sharpening machines made by this company.

On page 456f of the March 14 issue of the *American Machinist*, it was stated that the Hotchfield Steel Co. had leased a plant in Birmingham to manufacture steel drums and containers. The name was misspelled. It should read Hartsfield instead.

The Curtiss Aeroplane & Motor Co. has increased its board of directors to 16 from 13 members. The new directors are: Theodore P. Wright, chief aeroplane engineer; Arthur Nutt, chief motor engineer, and E. O. McDonnell, of G. M. P. Murphy & Company.

Whitman & Barnes, Inc. is the new name effective March 1, 1929, for the former Whitman-Barnes Detroit Corporation, according to W. H. Eager, president. The latter name, chosen at the time of the merger, was too cumbersome and the shorter name has been adopted.

The Muskegon Piston Ring Co., Muskegon, Mich., plans an increase of 50 per cent in the size of its plant. The company's output for 1929 is estimated at 60,000,000 rings, exclusive of the output of the proposed addition.

The Lycoming Manufacturing Co., subsidiary of the Auburn Automobile Co., Auburn, Ind., is erecting a factory to cost $500,000 at its Williamsport (Pa.) plant, which will be used exclusively for the manufacture of aircraft engines.

The Century Electric Co., St. Louis, has located a stock warehouse in Birmingham, Ala. All communications and orders, however, should be addressed to the Atlanta office at 420 Atlanta Trust Co. Building.

The Henry Lindahl Machine Co., 5900 Ogden Ave., Chicago, Ill., has changed its name to the Henry Lindahl Foundry & Machine Co. The concern manufactures castings and various power transmission appliances.

The National Acme Co., Cleveland, announces that its Detroit office and stockroom, with A. O. Bredemere as manager, has been moved to a ground floor section in the new building at 2826 East Grand Boulevard.

The American Machine & Foundry Co., Brooklyn, N. Y., manufacturer of labor-saving machinery for the tobacco industry, has acquired control of the American Oven & Machinery Co., of Chicago.

The S-P Manufacturing Co. has removed its factory to 7209 Platt Ave., Cleveland, and will devote its entire attention to the manufacture of air-operated chucking equipment.

The Whitney Metal Tool Co., Rockford, Ill., expects to buy up to $15,000 worth of new equipment for expansion and replacement purposes.

The Atlas Fence Co., Inc., Newark, N. J., plans the construction of a one-story plant for the manufacture of wire fence.

Personals

COL. BENJAMIN F. CASTLE, New York financier and former chief of the control board of the army air service in Washington, has been elected president of the Great Lakes Aircraft Corporation, Cleveland. The company recently acquired the former Glenn L. Martin plant in that city.

STUART NARAMORE, who for the past six years has been sales manager of Andrew C. Campbell, Inc., Bridgeport, Conn., manufacturer of nibbling machines, has resigned from that position, effective April 1, and will be connected with the Triplex Machine Tool Co., of New York, as Connecticut representative for the distribution of its line of machine tools.

HERBERT L. CUMMINGS, for 14 years with the machinery sales department of the National Acme Co., Windsor, Vt., has been appointed the New England representative of the concern. Mr. Cummings will operate from the company's New York office.

WILLIAM E. CROSS, president of the Hack Saw Association of America, Inc., and treasurer of the Victor Saw Works, Inc., is planning a three months' tour of Europe to study economic conditions in the various countries with the object of developing exports of hack saws.

CHARLES H. KERR has been appointed vice-president and general manager of the Brown Instrument Co., Philadelphia, Pa. At the same time GEORGE W. KELLER was appointed vice-president and general sales manager.

THOMAS H. WINSTON, 14 Guaranty Industrial Building, 2401 Chestnut St., Philadelphia, Pa., has been appointed representative of the Skinner Chuck Co., New Britain, Conn., for the Philadelphia territory.

H. W. STANDART, of the Northern Engineering Works, Detroit, was elected chairman of the Hoist Manufacturers' Association at the annual meeting.

Obituaries

ROSCOE B. JACKSON, president and general manager of the Hudson Motor Car Co., Detroit, died on March 19 at Mentone, France, at the age of 50. Mr. Jackson was one of the founders in 1909 of the present Hudson concern in association with Roy D. Chapin, Howard E. Coffin and the late J. L. Hudson. At one time he was factory manager of the E. R. Thomas Motor Co., Buffalo. For years he was one of the most reticent men in the automobile industry and seldom appeared in public and was never interviewed. His contact with associate executives was restricted to business conferences. For years he had no desk in the main administration building of the plant, but maintained an office of his own in the factory.

WILLARD L. VELIE, JR., acting president of the Velie Motors Corporation, Moline, Ill., died on March 20 at the age of 32. He was also president of the Mono Aircraft Corporation up until two days before his death. He became head of the Velie corporation at the time of the death of his father last October. He was a great grandson of John Deere, founder of Deere & Co., maker of agricultural machinery.

JOHN E. PILCHER, first vice-president of Simmons Hardware Co., St. Louis, Mo., died recently at the age of 84. A native of England, Mr. Pilcher came to this country as a boy. In 1863 he was engaged by the Simmons Hardware Co., with which he served continuously for 42 years. In later years he was connected with numerous important business enterprises.

MRS. ELEANORE CLARK WOOSTER, proprietor of the Stamford Pattern & Model Works, Stamford, Conn., died March 14 at her home. She had been ill for several weeks. Mrs. Wooster had been head of the business since the death of her husband 10 years ago. She was 49 years old.

E. C. MCCLURE, pioneer manufacturer of oil and gas drilling tools of Charleston, W. Va., died March 18 at the age of 78 years. With J. J. Davin he formed a partnership firm with a plant at Washington, Pa., in the earliest days of the drilling operations in that district.

Forthcoming Meetings

NATIONAL METAL TRADES ASSOCIATION. Convention, Hotel Drake, Chicago, April 24-25. J. E. Nyhan, national secretary, Peoples Gas Building, Chicago, Ill.

AMERICAN WELDING SOCIETY. Annual meeting, April 24-26, at the Engineering Societies Bldg., New York. M. M. Kelly, secretary, 29 West 39th St., New York.

AMERICAN MANAGEMENT ASSOCIATION. Annual meeting, Hotel Pennsylvania, New York, May 7. W. J. Donald, managing director, 20 Vesey St., New York.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—Eastern Spring meeting, Rochester, N. Y., week of May 13. Third national meeting of the aeronautic division, St. Louis, Mo., May 27-30. Semi-annual meeting, Salt Lake City, Utah, July 1-4. Third national meeting of the Iron and Steel Division, during the Steel Treaters' Exposition, Cleveland, September 11-13. Calvin W. Rice, secretary, 29 West 39th St., New York City.

AMERICAN GEAR MANUFACTURERS' ASSOCIATION. Thirteenth annual meeting to be held in the Hotel Statler, Cleveland, Ohio, May 16-18. T. W. Owen, secretary, 3608 Euclid Ave., Cleveland.

NATIONAL ASSOCIATION OF PURCHASING AGENTS. Annual convention, Hotel Statler, Buffalo, N. Y., June 3-6. B. W. Hall, assistant secretary, 11 Park Place, New York, N. Y.

AMERICAN SOCIETY FOR TESTING MATERIALS. Annual meeting, June 24-28, at the Chalfonte-Haddon Hall, Atlantic City, N. J. C. L. Warwick, secretary, 1315 Spruce St., Philadelphia, Pa.

SOCIETY OF AUTOMOTIVE ENGINEERS. Summer meeting, Saranac Inn, Upper Saranac Lake, N. Y., June 25-28. Coker F. Clarkson, manager, 29 E. 39th St., New York.

The Weekly Price Guide

Rise and Fall of the Market

VOLUME of steel production is assuming record proportions, with corporation mills at 97 per cent of capacity as against 88½ per cent a year ago and the Independents at 93 per cent, compared with 84 per cent at this time last year. The principal development of the week in steel prices, is a rise of 5c. per 100 lb., to $2.05, on reinforcing bars, f.o.b., Pittsburgh, in large mill lots of stock lengths. In non-ferrous metals, prices are substantially above last week's levels at principal cities, in lead, zinc, fabricated brass and copper products, and scrap material except zinc. A reduction of ¼c. per lb. in tin at New York, represented the major decline of the week.

(All prices as of March 22, 1929)

IRON AND STEEL

PIG IRON—Per gross ton, f.o.b:

CINCINNATI	
No. 2 Southern (silicon 1.75@2.25)	$19.94
Northern Basic	20.89
Southern Ohio No. 2	21.19
NEW YORK—Tidewater Delivery	
Southern No. 2 (silicon 1.75@2.25)	25.50
BIRMINGHAM	
No. 2 Foundry (silicon 1.75@2.25)	16.50
PHILADELPHIA	
Eastern Pa., No. 2x (silicon 2.25@2.75)	21.76
Virginia No. 2	27.17
Basic	20.76
CHICAGO	
No. 2 Foundry local (silicon 1.75@2.25)	20.00
No. 2 Foundry, Southern (silicon 1.75@2.25)	22.26
PITTSBURGH, including freight charge ($1.75) from Valley:	
No. 2 Foundry	19.26
Basic	19.26
Bessemer	21.26

IRON MACHINERY CASTINGS—Cost in cents per lb. of 100 flywheels, 6-in. face x 24-in. dia., hub not cored, good quality gray iron, weight 275 lb:

Detroit	4.50
Cleveland	5.00
Cincinnati	4.50
New York	5.25
Chicago	4.50@4.75

SHEETS—Quotations are in cents per pound in various cities from warehouse; also the mill base in large lots:

Blue Annealed	Pittsburgh Mill Base	Chicago	Cleveland	New York
No. 10	2.10@2.20	3.35	3.25	3.90*
No. 12	2.15@2.25	3.40	3.30	3.95*
No. 14	2.25@2.35	3.45	3.35	4.00*
No. 16	2.35@2.45	3.55	3.45	4.10*
Black				
Nos. 18 to 20	2.65@2.75	3.60	3.40	3.80
No. 22	2.80@2.90	3.75	3.55	3.95
No. 24	2.85@2.95	3.80	3.60	4.00
No. 26	2.95@3.05	3.90	3.70	4.10
No. 28	3.10@3.20	4.50	3.85	4.25
Galvanized				
No. 10	2.80@2.90	3.95	3.75	4.05
Nos. 12 to 14	2.90@3.00	4.05	3.85	4.15
No. 16	3.00@3.10	4.15	3.95	4.25
No. 18	3.15@3.25	4.30	4.10	4.40
No. 20	3.30@3.40	4.45	4.30	4.55
No. 22	3.35@3.45	4.50	4.35	4.60
No. 24	3.60@3.70	4.65	4.45	4.75
No. 16	3.75@3.85	4.90	4.70	5.00
No. 28	4.00@4.10	5.15	4.95	5.25

*Up to 3,999 lb.

WELDED STEEL PIPE—Warehouse discounts are as follows:

	New York		Cleveland		Chicago	
	Black	Galv.	Black	Galv.	Black	Glav.
1 to 3 in., butt welded	50%	36%	55½%	43½%	54%	41%
2½ to 6 in., lap welded	45%	32%	53½%	40½%	51%	38%

WROUGHT-STEEL PIPE LIST

Size, Inches	List Price per Foot	Diameter in Inches—External	Diameter in Inches—Internal	Thickness Inches
1	$0.17	1.315	1.049	.133
1¼	.23	1.66	1.38	.14
1½	.27½	1.9	1.61	.145
2	.37	2.375	2.067	.154
2½	.58½	2.875	2.469	.203
3	.76½	3.5	3.068	.216
3½	.92	4.0	3.548	.226
4	1.09	4.5	4.026	.237
4½	1.27	5.0	4.506	.247
5	1.48	5.563	5.047	.258
6	1.92	6.625	6.065	.28

SEAMLESS STEEL TUBING—Following net prices are for seamless mechanical tubing, cold drawn, round, .10 to .30 carbon, at New York warehouse in lots of less than 100 ft. or 100 lb:

Thickness—B.w.g. and Decimal Fractions		Outside Diameter in Inches—½	⅝	¾	⅞	1	1¼	1½
		Price per Foot						
.035"	20	$0.15	$0.16	$0.17	$0.18	$0.19	$0.21	$0.23
.049"	18	.17	.18	.19	.20	.21	.23	.25
.065"	16	.19	.20	.21	.22	.23	.25	.27
.083"	14	.20	.22	.23	.24	.25	.27	.29
.095"	13	.21	.23	.25	.26	.27	.29	.31
.109"	12	.22	.24	.26	.27	.28	.30	.32
.120" or .125"	11	.23	.25	.27	.28	.29	.31	.33
.134"	10	.24	.26	.28	.29	.30	.32	.34

MISCELLANEOUS—Warehouse base prices in cents per lb:

	New York	Cleveland	Chicago
Spring steel, light*	4.50	4.65	4.65
Spring steel, heavier	4.00	4.00	4.00
Coppered Bessemer rods	6.05	6.00	6.20
Hoop steel	4.25†	4.00	4.15
Cold rolled strip steel	6.25	6.00	6.10
Floor plates	5.10†	5.30	5.00
Cold drawn, round or hexagon‡	3.50	3.65	3.60
Cold drawn, flat or square‡	4.00	4.15	4.10
Structural shapes	3.30†	3.00	3.10
Soft steel bars	3.25†	3.00	3.00
Soft steel bar shapes	3.25†	3.00	3.00
Soft steel bands	3.75†	3.65	3.65
Tank plates	3.30†	3.00	3.10
Bar iron (2.75 at mill)	3.24	3.00	3.00
Drill rod (from list)	60%	55%	50%

*Flat, ¼-in. thick. †Up to 3,999 lb., ordered and released for shipment at one time. ‡Cold finished steel, shafting and screw stock.

Electric welding wire, New York, 3/32, 8.35c.; ⅛, 7.85c.; 5/32 to ½, 7.35c. per lb.

METALS

Warehouse Prices in Cents Per Pound for Small Lots:

Copper, electrolytic, New York			20.25
Tin, Straits, pigs, New York			51.50
Lead, pigs, E. St. Louis	7.70	New York	8.50
Zinc, slabs, E. St. Louis	6.60	New York	8.00

	New York	Cleveland	Chicago
Antimony, slabs	12.50	12.50@13.50	14.25
Copper sheets, base	29.12½	31.75	29.75
Copper wire, base	24.87½	23.25	22.87½*
Copper bars, base	27.62½	30.25	28.25
Copper tubing, base	30.12½	33.12½	31.25
Brass sheets, high, base	23.75	25.62½	24.12½
Brass tubing, high, base	28.62½	30.50	31.25
Brass rods, high, base	21.50	23.37½	21.87½
Brass wire, high, base	24.25	26.12½	24.62½

*At mill.

Shop Materials and Supplies

METALS—Continued

	New York	Cleveland	Chicago
Aluminum ingots, 99%.....	25.00*	24.30	24.30
Zinc sheets (casks).....	10.00@10.50	11.70	10.11
Solder (½ and ½).....	34.75	34.00	31@34

Babbitt metal, delivered in case lots, New York, cents per lb:

Genuine, highest grade.....	69.00
Commercial genuine, intermediate grade.....	53.00
Anti-friction metal, general service.....	31.50
No. 4 babbitt (f.o.b.).....	12.25

*Delivered.

NICKEL AND MONEL METAL—Price in cents per lb., base, f.o.b. Huntington, W. Va:

	Nickel	Monel Metal
Sheets, full finished.....	52.00	42.00
Sheets, cold rolled.....	60.00	50.00
Strip, cold rolled.....	55.00	45.00
Rods, hot rolled.....	45.00	35.00
Rods, cold rolled.....	53.00	40.00†
Tubing.....	75.00*	90.00
Angles, hot rolled.....	50.00	40.00
Plates.....	52.00	42.00

*Seamless. †Cold drawn.

OLD METALS—Dealers' purchasing prices in cents per pound, f.o.b. cars, depending on quantity offered for sale:

	New York	Cleveland	Chicago
Crucible copper.....	18.00 @18.25	15.25	15.75 @16.25
Copper, heavy, and wire..	17.00 @18.00	14.75	15.12½@15.50
Copper, light, and bottoms	15.50 @16.00	12.50	13.75 @14.25
Heavy lead.....	6.25 @ 6.50	6.25	5.25 @ 5.75
Tea lead.....	4.62½@ 5.12½	4.25	4.25 @ 4.75
Brass, heavy, yellow.....	10.50 @11.00	10.00	9.75 @10.25
Brass, heavy, red.....	.....	12.75	13.00 @13.50
Brass, light.....	8.50 @ 9.00	8.25	8.75 @ 9.25
No. 1 yellow rod turnings.	11.00 @11.50	10.50	10.75 @11.25
Zinc.....	3.25 @ 3.75	3.25	3.00 @ 3.50

TIN PLATES—Charcoal—Bright—Per box:

	New York	Cleveland	Chicago
"AAA" Grade:			
IC, 14x20.....	$12.10	$11.95	$11.50
"A" Grade:			
IC, 14x20.....	9.70	9.90	9.50
Coke Plates—Primes—Per box:			
100-lb., 14x20.....	6.45	6.10	7.00
Terne Plates—8-lb. Coating—Small lots—Per box:			
IC, 14x20.....	7.75@8.00	7.00	7.50

MISCELLANEOUS

	New York	Cleveland	Chicago
Cotton waste, white, per lb.*	$0.10@0.13½	$0.16	$0.15
Cotton waste, colored, per lb.*	.09@ .13	.12	.12
Wiping cloths, washed white, per lb.†.....	.16	38.00 per M	.16
Sal soda, per lb.....	.02	.02	.02
Roll sulphur, per lb.....	.027	.03½	.04
Linseed oil, raw, in 1 to 4 bbl. lots, per lb.....	.11	.11	.114
Cutting oil, about 25% lard, in 5 gal. cans, per gal.....	.55	.60	.65
Machine oil, medium-bodied (55 gal. steel bbl.) per gal..	.33	.36	.35
Belting — Present discounts from list in fair quantities (½ doz. rolls) for leather or rubber:			
Leather—List price, 24c. per lin. ft., per inch of width, for single ply:			
Medium grade.....	30–10%	30–10%	35%
Med. grade, heavy wgt...	30– 5%	30– 5%	30%
Rubber transmission, 6-in., 6 ply, $1.83 per lin.ft:			
First grade.....	50%	50–10%	50%
Second grade.....	60%	60– 5%	50–10%

*All waste in bale lots. †100-lb. bales.

Comparative Warehouse Prices

New York	Unit	Current Price	Four Weeks Ago	One Year Ago
Soft steel bars.....	per lb..	$0.0325	$0.0325	$0.0324
Cold drawn shafting...	per lb..	.035	.035	.034
Brass rods.....	per lb..	.215	.2025	.165
Solder (½ and ½).....	per lb..	.3475	.35	.3325
Cotton waste, white...	per lb..	.10@.13½	.10@.13½	.10@.13½
Disks, aluminum oxide mineral, cloth, No. 1, 6-in. dia.....	per 100.	3.59	3.59	3.10
Lard cutting oil.....	per gal.	.55	.65	.65
Machine oil.....	per gal.	.33	.30	.27
Belting, leather, medium.....	off list..	30–10%	30–10%	35%
Machine bolts, up to 1x30 in., full kegs...	off list..	50-10%*	50–10%*	50%*

*List prices as of April 1, 1927.

MISCELLANEOUS—Continued

	New York	Cleveland	Chicago
Abrasive materials — Standard grade, in sheets 9x11 in., No. 1, per ream of 480 sheets:			
Flint paper.....	$4.05	$4.29	$4.29
Emery cloth.....	20.22	20.97	20.97
Disks, aluminum oxide mineral, 6 in. dia., No. 1, per 100:			
Paper.....	2.04	2.04	2.04
Cloth.....	3.59	3.59	3.59
Fire clay, per 100 lb. bag.....	1.00	.75	.75
Coke, prompt furnace, per net ton...	Connellsville,		2.75@2.85
Coke, prompt foundry, per net ton...	Connellsville,		3.75@4.50
White lead, dry or in oil...	100 lb. kegs....	New York,	13.50
Red lead, dry.....	100 lb. kegs....	New York,	13.50
Red lead, in oil.....	100 lb. kegs....	New York,	15.00

SHOP SUPPLIES

Discounts from new list dated Apr. 1, 1927, applying on immediate deliveries from warehouse stocks in New York and vicinity:

Machine bolts:	
Up to ¾-in. x 6-in., full kegs, list less.....	60%
Larger, up to 1 x 30-in., full kegs, list less.....	50–10%
Less than full kegs or case lots, add to list.....	10%
Fitting-up bolts: list less.....	45%
Lag screws:	
Up to ½-in. x 6-in., list less.....	60%
Larger, list less.....	50–10%
Less than full keg or case lots, add to list.....	10%
Rivets:	
Structural, round head, full kegs, net.....	$4.50
Structural, round head, broken kegs, net.....	6.00
Tank, 7–16-in. dia. and smaller, list less.....	60%
Nuts:	
Hot pressed, square or hexagonal, blank or tapped:	
Full kegs up to 1-in., incl., list less.....	60%
Larger, up to 3-in., list less.....	40–10%
Less than keg or case lots, add to list.....	10%
Washers:	
Wrought, full kegs, per 100 lb., list less.....	$4.00
Wrought, broken kegs, per 100 lb., list less.....	2.00
Turnbuckles:	
With stub ends, list less.....	20%
Without stub ends, list less.....	50%
Chain:	
Proof coil, base, per 100 lb., net.....	$7.10
Cast iron welding flux, per lb., net.....	.40
Brazing flux, per lb., net.....	.80

Machine Requirements and Industrial Construction

Equipment Wanted

Mich., Detroit—Cadillac Motor Car Co., Clark Ave.—machinery and equipment for proposed 2 story foundry. Estimated cost $340,000.

Mich., Detroit—Chadwick Mfg. Co., 12281 Turner Ave., L. W. Chadwick (bushings and tools)—machine shop equipment for proposed extension to plant.

Mich., Detroit—Frederick Colman & Sons, 7250 Central Ave.—drill presses.

Mich., Detroit—McManus Steel Co., 3290 Wight St.—miscellaneous sheet metal shop equipment for proposed 1 story iron work factory. Estimated cost $50,000.

Mich., Detroit — V. Tool & Die Co., 439 East Fort St.—shaper.

Mich., Detroit — Vulcan Iron & Wire Works, 409 East Fort St.—light press.

Mich., Lansing—Olds Motor Works, 1101 Division St. — equipment for the manufacture of automobile body and motor parts of sheet metal for proposed 1 story, 180 x 500 ft. factory.

Mo., St. Louis—City Water Dept. G. J. Dietz, Supply Comr. — will receive bids until Apr. 1, for a lathe.

O., Canton—Ohio Highway Dept., Ohio-Hartman Bldg., R. N. Waid, Dir., 18 in. lathe drill press, two grinders, forge and bench tools, etc. for proposed garage.

O., Cleveland—L. Abrams, Engineers Bank Bldg. (realty operator)—10 ton crane for proposed 1 story, 50 x 200 ft. factory on Trumbull Ave. Estimated cost $400,000.

O., Cleveland — Bd. of Education, 421 Rockwell Ave., H. E. Boppel, Purch Agt.—will receive bids until Apr. 8, for four wood turning lathes, two 7 ft. bed and two 4 ft. bed, two lathes, 5 ft. x 11 in., two hand jointers, two 30 in. band saws, two saw benches, two wheel grinders, two sanding machines, two oil stone tool grinders and two 10 in. sensitive drill presses.

O., Columbus — Bd. of Education, 270 East State St., W. V. Drake, clk.—will receive bids until Apr. 22, for ten lathes, three 12 x 60 and one 12 x 84, others various sizes; drill press, band saw, grinder, joiner, crank shaver, power hack saw, etc. for manual training department.

O., Youngstown—Commercial Shearing & Stamping Co., 1775 Logan Ave.—geared press.

Ont., Hamilton — Bd. of Education, J. Poag, Chn.—technical shop equipment for proposed high school. Estimated cost $850,000.

Ont., London—Canadian Richards Wilcox Co., Watt and Blackwell Sts., W. R. Yendall, Mgr.—machinery and equipment for the manufacture of garage doors and equipment for proposed 1 story, 60 x 120 ft. addition to factory at Chelsea Green. Estimated cost $45,000.

Ont., London—E. Leonard & Sons, E. I. Leonard, Mgr.—machinery and equipment for proposed 1 story, 60 x 100 ft. addition to boiler shop on York St. Estimated cost $40,000.

Opportunities for Future Business

Ala., Anniston—King Metal Products Co., T. C. King, Pres. (recently incorported), plans the construction of a plant for the manufacture of steel cast products.

Calif., Berkeley—Dept. of Public Works, Division of Architecture, Sacramento, plans the construction of a broom factory, etc. here. Estimated cost $340,000.

Calif., Emeryville—Western Electric Co., 680 Folsom St., San Francisco, awarded contract for a 5 story factory. Estimated cost $500,000.

Calif., Los Angeles — Bd. of Education, will soon award contract for a 1 and 2 story Bret Harte school including 1 story, 68 x 360 ft. shop, etc. Estimated cost $300,000.

Calif., Riverside—Southern Sierras Power Co., awarded contract for a group of industrial buildings to include 32 x 120 ft. 40 x 110 ft. assembly shops, 32 x 140 ft. storage sheds, etc. Estimated cost $165,000.

Calif., South Gate—Willard Storage Battery Co., East 131st St. and St. Clair Ave., Cleveland, O., plans the construction of a factory here. Estimated cost $250,000.

Calif., Van Nuys—Commercial Aircraft Corp., Pacific South Western Bldg., Pasadena, is receiving bids for the construction of an 85 x 225 ft. factory and 30 x 60 ft. paint shop here. Noted Jan. 31.

Conn., Bridgeport—Bridgeport Brass Co., R. Day, Gen. Mgr., will soon award contract for a 1 story, 75 x 200 ft. plant on Housatonic Ave. Estimated cost $100,000. Fletcher-Thompson Inc., 542 Fairfield Ave., Archt. Noted Mar. 14.

Conn., Bristol—Wallace Barnes Co., 30 Main St., manufacturers of springs, awarded contract for a 5 story, 40 x 60 ft. factory. Estimated cost $250,000. Noted Dec. 27.

Ill., Chicago—Merit Co., 2125 Rice St., manufacturers of metal burial caskets, is having sketches made for a 3 story, 115 x 315 ft. factory at Augusta St. and Cicero Ave. Estimated cost $350,000. Architect not selected.

Ill., Chicago — Silver-Marshall Co., 846 West Jackson Blvd., radio manufacturers, awarded general contract for the construction of a factory at Natchez Ave. and 65th St.

Ill., Chicago — Thorne Motors Corp., W. Thorne, Pres., 3231 West Lake St., awarded contract for a 1 story factory at Melvina and West 65th Sts.

Ill., Harvey — Buda Co., manufacturers of engines and railroad supplies, awarded contract for a 1 story, 60 x 100 ft. addition to foundry on Halsted St. Estimated cost $20,000.

Ill., Quincy — Otis Elevator Co., G. Gardner, Works, Mgr., awarded contract for addition to foundry and storage building at Walton Heights.

Ind., Fort Wayne—Fisher Paper Co. is having plans prepared for a 1 story, 70 x 150 ft. machine shop and garage at Lafayette and Main Sts. Estimated cost $46,000. A. M. Strauss, 415 Cal-Wayne Bldg., Archt.

Ind., Jasper—New Indiana Chair Co., c/o E. C. Berendes, 108 McCurdy Bldg., Evansville, Archt., will receive bids until April 8 for a 2 story, 300 x 300 ft. factory here. Estimated cost $75,000.

Me., Lewiston—American Electro Metal Corp., I. P. Schwarzkopf, awarded contract for a 1 story, 110 x 130 ft. plant and laboratory. Estimated cost $65,000. Noted Feb. 28.

Mass., Cambridge (Boston P. O.)—North Cambridge Community Church, W. Weens, 28 Hubbard St., awarded contract for the construction of a church including vocational shop, etc. at North Cambridge. Noted Feb. 28.

Mass., Quincy—Bethlehem Shipbuilding Corp., 97 East Howard St., had plans prepared for a 2 story addition to joiner shop at Fore River plant. H. V. Bisbee, Co. Archt.

Mo., Bridgeton—Robertson Aircraft Co., Lambert-St. Louis Flying Field, plans the reconstruction of airplane hangar into airplane servicing building. Estimated cost $45,000.

N. J., Avon—Sheet Metal & Roof Craftsman, c/o W. H. Conover, 114 Liberty St., New York, awarded contract for a 2 story shop here. Estimated cost $50,000.

N. J., Secaucus — New York Air Terminals, Inc., c/o Hayden-Stone & Co., 25 Broad St., New York, is having plans prepared for the construction of an airport including shops, hangars, etc. Estimated cost $1,500,000.

N. Y., Brooklyn—United Metal Box Co., S. Klein, Pres., President and Nevins Sts., will soon award contract for addition to plant. Estimated cost $40,000. M. J. Harrison, 63 Park Row, Archt. Noted March 14.

N. Y., Buffalo — Owner, c/o Reidpath & Wilson, 1057 Gerranc Bldg., Archts., plans the construction of a 1 and 2 story, 103 x 130 ft. machine shop. Estimated cost $60,000.

N. Y., Poughkeepsie—S. H. Chadwick, 140 Cedar St., New York, Engr., will receive bids about May 1 for the construction of a foundry here for DeLaval Separator Co., Pine St., Poughkeepsie. Estimated cost $150,000.

N. Y., Syracuse—Continental Can Co., 1 Pershing Sq., New York, awarded contract for the construction of a plant at 1016 East Water St. Estimated cost $50,000. Francisco & Jacobus, 511 5th Ave., New York, Archts. and Engrs.

O., Cleveland—Carnegie Body & Top Co., E. S. Eckstein, Secy. and Treas., 6115 Carnegie Ave., awarded contract for a 1 story, 97 x 155 ft. addition to shop. Estimated cost $60,000. Noted Mar. 7.

O., Cleveland—Cleveland Heater Co., 1900 West 112th St., awarded contract for a 1 story, 72 x 100 ft. addition to factory. Estimated cost $40,000. Noted Mar. 14.

O., Cleveland—Scott & Fetzer Co., 11401 Locust Ave., manufacturers of vacuum cleaners, is having plans prepared for a 2 story, 50 x 216 ft. addition to factory at North 114th St. and Locust Ave. Estimated cost $60,000. A. C. Wolf, Swetland Bldg., Archt.

O., Dayton—National Cash Register Co., Main and K Sts., will soon award contract for a 6 story addition to plant at Rubison and Brown Sts. Estimated cost $1,000,000. Private plans. Noted Mar. 14.

O., Geneva—American Fork & Hoe Co., G. B. Durrell, Pres., B. F. Keith Bldg., Cleveland, is having plans prepared for a 2 story, 40 x 200 ft. factory here. Estimated cost $40,000. C. B. Rowley, B. F. Keith Bldg., Cleveland, Archt.

O., Toledo—Air Reduction Co., Lafayette and Michigan Sts., will build a factory. Estimated cost $250,000.

Pa., Bloomsburg — Magee Copper Co., awarded contract for a 4 story, 75 x 280 ft. spinning plant. Estimated cost $300,000.

Pa., Pittsbugh — Heppenstall Forge & Knife Co., 4620 Hatfield St., awarded contract for a 1 story, 60 x 71 ft. annealing building at 47th and Harrison Sts. Estimated cost $40,000.

Pa., Rouseville—Rouseville Cooperage Co., is receiving bids for a 1 story, 100 x 180 ft. barrel factory. Estimated cost $100,000. Private plans.

Pa., Warren—Thomas Flexible Coupling Co., awarded contract for a 1 story, 60 x 200, 40 x 100, and 40 x 60 ft. plant. Estimated cost $50,000. Mar. 7.

B. C., New Westminster—Western Hardware & Steel Co., C. D. Hobbs, Granville Island, Vancouver, plans the construction of a small electric furnace and rolling mill here. Estimated cost $500,000.

Ont., Hamilton — Otis-Fenson Elevator Co., Victoria Ave. N., is having plans prepared for a 2 story, 75 x 100 ft. addition to plant. Estimated cost $100,000. Hutton & Sauter, 6 James St. S., Archts.

Ont., Toronto—Canadian Scale Co., Ltd., 12 Rebecca St., awarded contract for a 1 story, 56 x 100 ft. factory. Estimated cost $50,000.